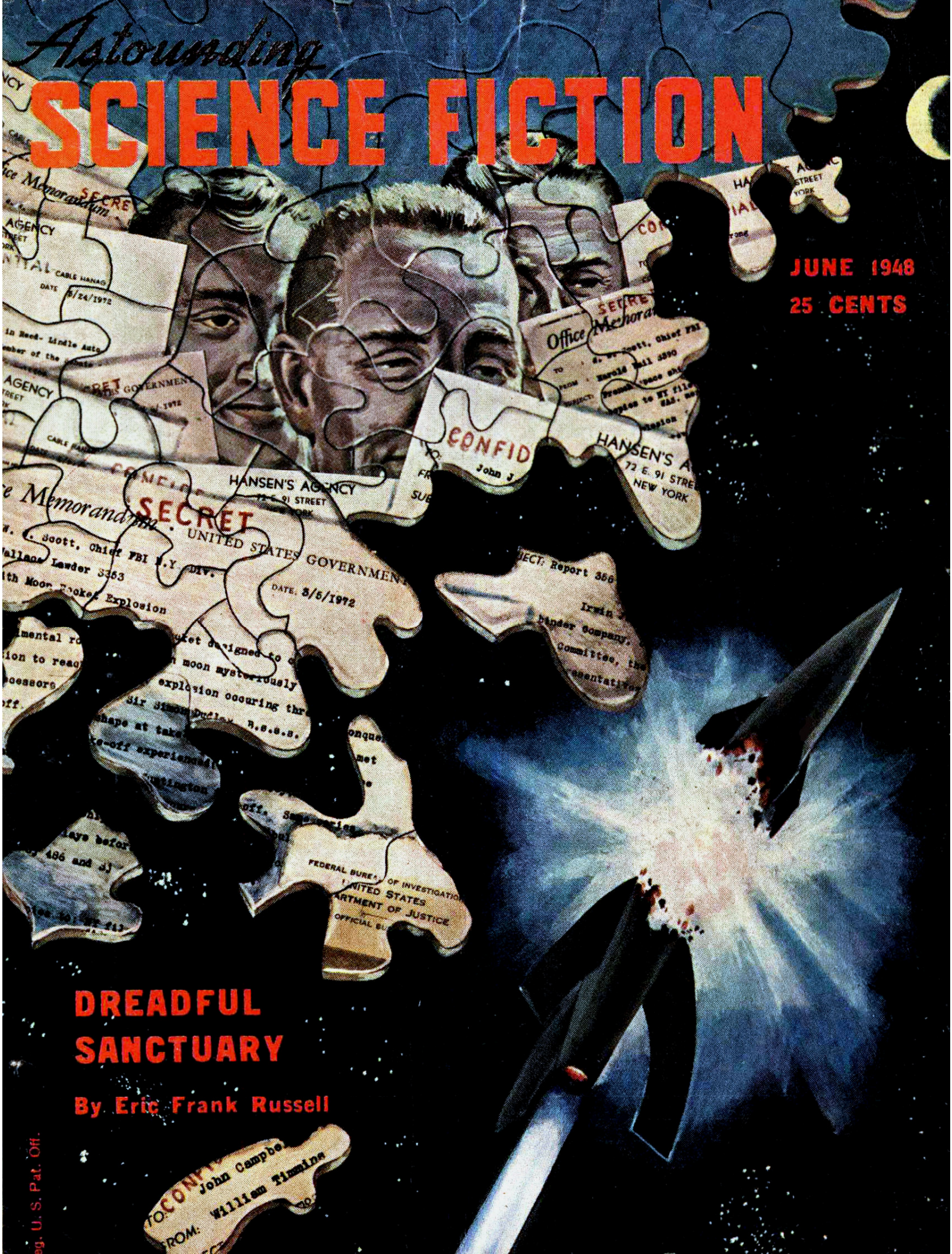
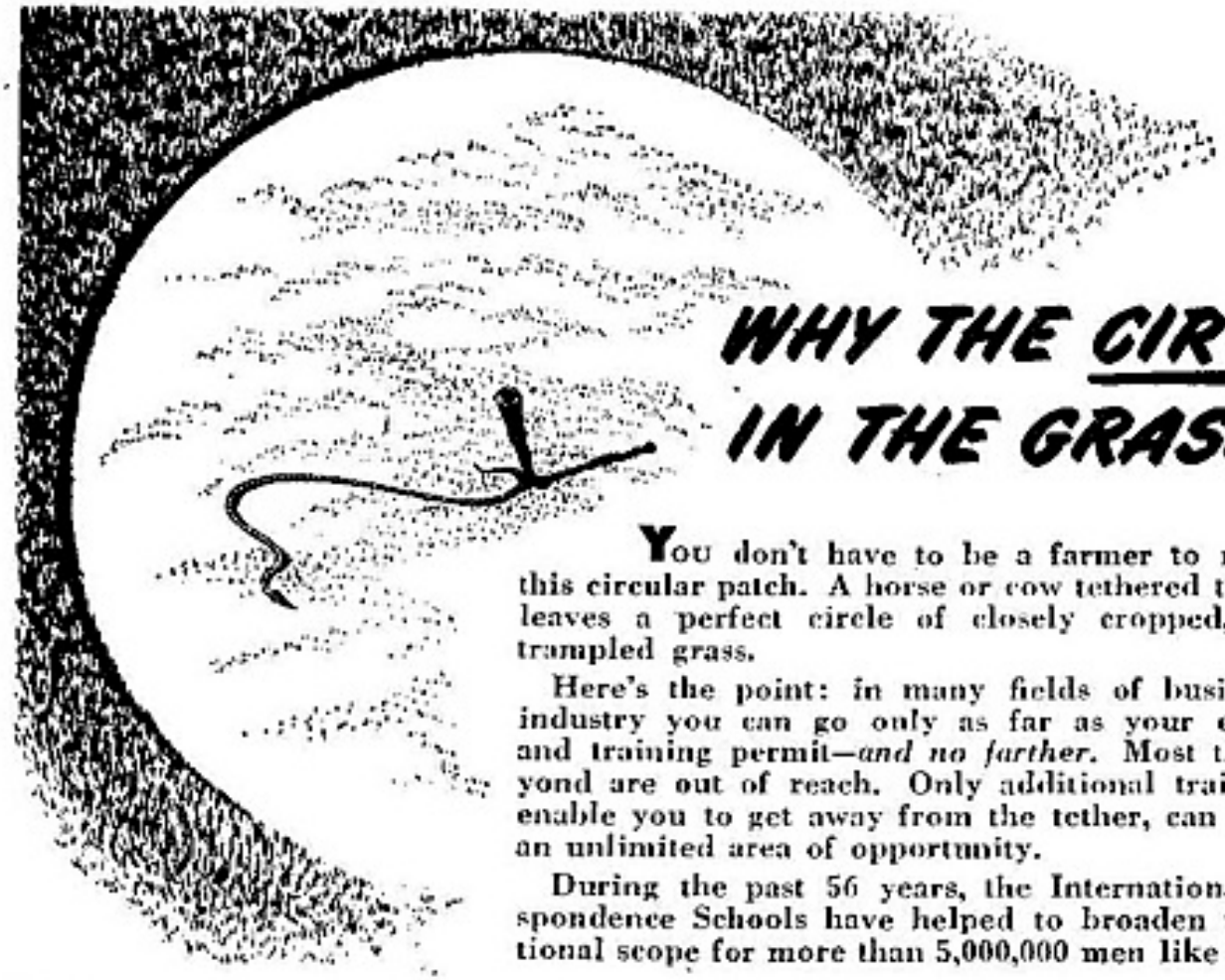


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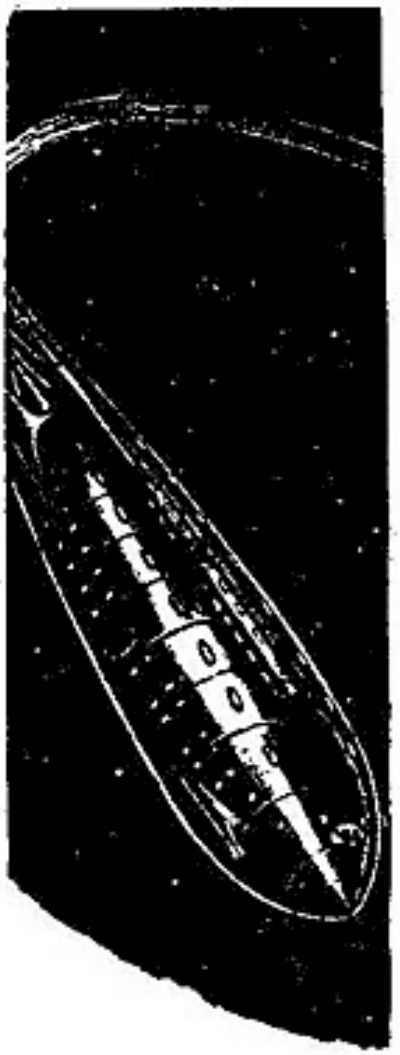
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NEXT ISSUE ON SALE JUNE 15, 1948

ATOMIC POWER PILE

Recently, considerable highly interesting data on atomic piles has been released; specifically, the new data deals largely with the purely engineering aspects of nuclear reactors. Much of it discusses the problems of extracting heat energy from the piles for useful application in generating electric power, or running steam turbines. The problem is a dilly, and can be approached readily from a science-fiction slant.

Atomic energy is the most concentrated energy storage known. We haven't yet learned to release the total energy of matter by the annihilation of the nucleon; we only rearrange the nucleons of uranium into a more efficient structure. This nevertheless releases an immense concentration of energy. Science-fiction has long held to the interesting concept of an atomic engine as big as a typewriter that could deliver a million horsepower; that is, today, known to be literally and specifically true. An atomic engine, burning U-235 or Pu-239 as fuel, can be built no larger than a modern typewriter, and of about the same weight, that can supply energy at a rate of 1,000,000 horsepower.

Where science-fiction gaily skips along, however, the engineer has come a serious cropper. O.K.—so you've got a gadget that will generate 1,000,000 horsepower in one cubic foot; now get it out! For the purpose of argument, let's go to some theoretical ultimates. Suppose it releases the energy as pure electric current. Make it 1,000,000 kilowatts instead of a million horsepower for convenience in figuring. That's one billion watts, which may be delivered at a million volts at a thousand amperes, a thousand volts at a million amperes, or any pair of current-times-voltage figures that yield a product of one billion. Actually, if the terminals are to be only one foot apart—our one-cubic-foot-engine's sides—it can't be much more than about 200,000 volts because of danger of arc-over. That would require a current of 5,000 amperes. A one-foot square copper bus-bar would handle that satisfactorily—but not much more. Our atomic engine is rather impractically small, because the bus-bars handling its output are bigger than it is.

If it's mechanical power—our one-foot-cube engine turning a

shaft—we'll have to have something very fancy in the way of shafting. One million horsepower into a 12" diameter steel shaft would twist it into a pretzel unless it is turning at a fantastic speed. And tying down the engine so it doesn't tear loose from its bed-bolts will take some doing, too.

But those are fantasies; actually, we can only make our one-foot-cube engine deliver the million kilowatt or million horsepower output as pure heat energy. The atomic reaction can yield that energy: it can put it out at any temperature you name, up to a couple of billion degrees—at which point the controls stop working, but the energy release action does not—if you can absorb and use the power. The present knowledge of atomics permits us to release the energy in an extremely concentrated pile. Engineering knowledge of energy transfer, however, is utterly inadequate to the task of transducing that energy into another form at the rate it can be released.

Using highly enriched—nearly pure—U-235 or Pu-239, a pile as small as a single foot cube is perfectly possible. It can be operated under perfect control. But no engineering device known to man can absorb the energy it releases at anything like the rate that one-foot cube is capable of. Using natural uranium in a heavy-water moderated pile, much greater volume is necessary to make the atomic action take place. There must be a volume of heavy water sufficient to act as moderator; still, a natural-uranium, heavy-water pile only six feet on an edge is probably entirely practical—atomically. This pile would be capable of generating a full million kilowatts—if you can find a way to carry that much energy away. If the heavy water is confined under unlimited pressure, it can be kept liquid, or maintained as a super-compressed gas of liquid density up to about 2800°C. at least—the temperature at which decomposition of water begins to be detectable. Uranium melts at around 1200°C. But even at such temperatures, transferring the immense amount of heat one million kilowatts represents out of a heat-generator only six feet on a side is a problem we are not now in a position to handle.

The graphite-moderated pile must be larger, since graphite is a less efficient moderator than heavy hydrogen, but even that larger—perhaps 9-foot-cube—pile is far too concentrated for easy heat extraction. Getting as much as 1,000 megawatts of heat energy out of so small a volume is a terrific problem under any circumstances; getting out the heat and not absorbing the essential neutrons at the same time is an even tougher problem, naturally.

The obvious and apparently simple remedy would be to make the pile bigger, and run it at a lower concentration. That's not so simple an answer. The super-pure graphite is expensive; the uranium slugs are expensive; the whole pile structure is expensive. You simply can't use more graphite and make the pile

bigger that way, because graphite does absorb neutrons; if there is too much graphite the pile won't work. Both the uranium and the graphite must be increased; the original pile simply has to be run at a lower intensity—it has to be crippled, hamstrung till it can't react with the full speed of which it is capable.

The trouble is in absorbing the heat within the pile and pumping it out. Many possible heat-transfer agents have been suggested, both gases, normal liquids, and liquid metals. The requirements are of two types, however, and are frequently mutually exclusive. For instance, some of the organic liquids now used commercially as heat transfer agents—diphenyl ether for instance—can't be used in a pile, because the enormously high concentration of ionizing radiations, both gamma. beta, and neutrons, would rapidly break down the complex molecules. Fused inorganic salts could be used; such simple molecules would simply recombine as fast as ionizing radiation broke them up. Elementary gases—hydrogen or helium for example—would be immune to ionization damage. Water could be used—presumably heavy water, since ordinary hydrogen atoms absorb neutrons rather severely—but it is impracticable to run the water temperature very high. If the water is heated to, say, 900°F., it must be handled under high pressure. That means thick-walled pipes, and thick-walled pipes impede the flow of heat from the uranium metal—where ninety per cent of the heat is generated—to the heat-transfer agent. The bulk of metal would also interfere with the nuclear reactions. Thin-walled pipes are wanted, but water isn't a liquid at 900°F under normal pressures. Gases as heat-transfer agents are undesirable because there is so little heat-absorbing mass of matter in a cubic foot of gas as compared to a cubic foot of water. Liquid metals are also suggested, but many are ruled out because they are neutron absorbers. Mercury, for instance, is none too good in that respect. Lead and bismuth and tin are all allowable; tin perhaps best because it has such an extremely wide liquid range—it boils above 2500°C. Liquid alkali metals such as sodium and potassium might do. But whether a liquid metal, a liquid like water, or a gas is used, the overwhelming problem is very simple:

The atomic engine is too immensely compact to permit us to use its full output possibilities.

THE EDITOR.

* * * * * * * * * *



DREADFUL SANCTUARY

BY ERIC FRANK RUSSELL

First of three parts. In which it is shown that a deadly—and plausible—idea is just as deadly whether it be true or not!

Illustrated by Timmins

I.

The premature explosion of the seventeenth Moon-rocket ushered in the year 1972. There was nothing spectacular about the big bang which was modified by distance. To the naked eye the sudden flare-up of its signal-load of magnesium appeared as no more than a short, sharp twinkle of intense brilliance on or near the surface of the Moon.

But the event caused something of a turmoil.

Reasons for the sensation were threefold. Firstly, nothing more sensational occupied the headlines at that time. Secondly, the rocket had been manned. Thirdly, its origin was Russian. Prior to this, sixteen successive failures had got the public used to it. The little man in the street accepted that Moon-rockets crack up just as he accepted that airplanes often crack down, official reassurances notwithstanding. Of the sixteen flops, eight had been American, four British, three French and one Canadian, all crewless and automatically controlled. Dollars had been burned aplenty, but no lives lost.

Public opinion, reacting from repeated dollops of pre-launching propaganda, sought explanations for continual failures. The public found two: either the technicians weren't as technically infallible as they pretended, or else they were being craftily sabotaged by some crackpot organization determined to stop rockets from reaching the Moon. Propagandists encouraged the second theory, not from political hatred or any real faith in it, but as a means of diverting attention from the first and less desirable idea. Obediently, those thus diverted looked around for possible saboteurs. Those Russkis!

When thirty million rubles blazed momentarily in space, and Mikichenko along with them, the complex became inhibited. It couldn't be the Russkis after all. Some other reason must be found. The taxpayer, miserably conscious of his taxes, swung right back to reason number one. Leftist logrollers, financial theorists and others helped boost the swing by talking about capitalistic destruction of surpluses. That annoyed John Doe. He pictured his own wad on the bonfire and began to scream.

Such was the situation when John J. Armstrong read an article by Professor Mandle in the *Herald*. The professor was in favor of a Mandle Layer. According to him, this was a lethal electromagnetic envelope surrounding the Moon at a distance which varied from day to day, possibly between ten and twelve thousand miles from the lunar surface. Here was a new notion moderately supported by what little data was available.

Armstrong was a big, tweedy man, burly, broad-shouldered and a heavy punisher of thick-soled shoes. His thinking had a deliberate, ponderous quality. He got places with the same unracy, deceptive speed as a railroad locomotive, but was less noisy. Straining his chair to its limits as he leaned his two hundred pounds backward, he eyed the glowing television screen on which the *Herald*'s cogent page was reproduced, stewed the theory in his mind.

Finally, he dialed his phone, got Mandle. The professor's face swam into his screen, young, swarthy, curly-headed.

"I don't suppose you know me. My name's John J. Armstrong," he told Mandle. "I've a finger in the

eighteenth rocket now building in New Mexico. Whether it'll ever get finished is another matter seeing that the public's starting to howl about it. If Congress also starts, guess we'll have to give up or go elsewhere."

"Yes, I'm aware of the position." Mandle looked sympathetic.

"I've been reading your bit in today's *Herald* recording," Armstrong went on. "If there's anything in your theory we might as well scrap the ship and have done with it. So I want to ask you a couple of questions. Firstly, can you think of any means whereby we can get the measure of this layer without destroying a ship? Secondly, do you think it might be possible eventually to combat this snag and drive through?" He paused, added, "Or are we banned from the Moon for all time?"

"Now, look," answered Mandle, "all the data radioed back by auto-controlled rockets proves beyond doubt that there's an ionized envelope around the Earth. Ergo, around the Moon may be another, superficially similar, but not the same. Its nature is speculative. But eleven of the seventeen ships exploded between ten and twelve thousand miles from the satellite when they'd covered ninety-five per cent of their intended journey. That's coincidence too many times repeated to be coincidence; it's a phenomenon with some law back of it."

"Humph," grunted Armstrong. "The other six never got that far. In fact two of them blew to blazes at the moment of launching."

"We must make allowances for the human factor, for faulty design, flawed workmanship, errors of judgment and so forth. All those rockets, as you must know, were crewless and auto-controlled because we're still feeling in the dark and must recognize hazards. I consider it inevitable that with the best will in the world a few of the first rockets should prove failures long before they reach this critical point near the Moon."

Armstrong rubbed his heavy chin with a thick and hairy hand. "Yes, maybe. But since they've boosted through the Appleton and Heaviside Layers with no more trouble than a rise in temperature and an upped cosmiray-count, I don't see why they should blow apart at this lunar layer, if it exists."

"Because it's not the same," Mandle asserted with a touch of impatience. "I can conceive its existence without knowing its nature. Maybe it causes spontaneous disruption of the fuel, or the signal powder, or the entire fabric of the ship. I don't fancy that notion, myself. My guess would be that it causes overheating so intense that the ship gets burned apart like a meteor plunging through our atmosphere. If the overheating comes from some queer radiation which is inherent to the lunar field, I don't see what can be done about it. But if it comes from friction then you might penetrate by reducing velocity below the critical point."

"This eighteenth rocket is designed to be manned." Armstrong pointed out grimly. "A crackpot

named George Quinn is going to squat in its nose. We don't want him burned up. How're we going to prevent it?"

Mandle hesitated, his features showing thoughtfully in the little screen. "The only useful suggestion I can make," he said slowly, "is to have an auto-controlled pilot rocket running ahead of him. If the tow are fitted with sympathetic recorders, and . . . and—" His dark eyes looked at Armstrong steadily, unwinking. Then his face slid gradually from the screen.

Staring into the empty area of fluorescence, Armstrong waited for him to reappear. His watch lasted a long time. In the end, he frowned, pressed the emergency button.

When the operator came on, he complained, "I was talking to Professor Mandle at Westchester 1042. What's happened?"

She disappeared, returned in a minute with, "Sorry, sir, your correspondent does not answer."

"What is his address?"

Her smile was courteous, apologetic. "I regret, sir, we are allowed to reveal subscribers' addresses only to the police."

"Then get me the Westchester police," he snapped.

To the official who answered, he spoke swiftly: "This is John J. Armstrong, Greenwich 5717. Something's gone wrong at the home of Professor Mandle, Westchester 1042. You'd better get round there fast!" He switched off, switched on again, got the *Herald*, asked for extension twelve, and said: "Morning, Bill! No time to waste—I want something quick. Can you give me the address of Professor Mandle whose article you ran in the last edition?" He listened awhile, got it, rumbled, "Thanks! I'll call you again later."

Grabbing his hat, he raced out front, heaved his great bulk under the steering wheel of his car, jabbed the powerful machine into action. Within him was the queezy feeling that Mandle had nothing more to say—ever.

Definitely Mandle had nothing further to voice. He was deader than last month's bottles. He reposed extravagantly on the carpet beneath his phone, his features calm, composed, his body cold.

An authoritative, gray-mustached individual moved around the body, said: "You're the Armstrong who rung us up? Quick-witted of you. We came right away but were too late."

"What caused it?" Armstrong inquired.

"Can't say yet. Looks like he kicked the bucket quite naturally. The autopsy will tell us why." His glance at the other was keen and calculating. "Was he very excited when talking to you, or apprehensive, or in any way abnormal?"

"No—he seemed O.K. as far as one can judge from those dime-sized screens." He studied the body morbidly. "Quite a young chap. In his late twenties, I'd say. Bit unusual for young ones to shuffle off like this, isn't it?"

"Not at all," the other scoffed. "They do it every day." He shifted

his gaze from his listener as a uniformed policeman entered the room, barked at the latter: "That the meat wagon?"

"Yes, Cap."

"All right. Lug it away. There's nothing to interest us here." He turned back to Armstrong. "If you want the result of the autopsy, I'll phone it to you. Greenwich 5717 you said?"

"Yes, that's right."

The police captain grew slightly curious. "You a relative?"

"Oh, no. I was consulting him about a technical matter. It gave me a jolt when he slid out on me like that."

"I suppose it would." The captain pendulumed his hat, took a final, morose look around the room, tossed the hat carelessly onto his head. "Some of us get used to it, though." He went out.

Armstrong made it to the *Herald*, called for Bill Norton, took him to lunch. The café was small, homey, its rare steak excellent. He ate his way through the menu before saying anything.

"Mandle's dead. He went off while talking to me. It's a lousy trick to play on somebody before the conversation's finished."

"I've heard of lousier," Norton informed. "There was the case of the guy who suddenly went nuts and—"

"Never mind the journalistic reminiscences," put in Armstrong. "This event has left me sort of suspended in midair. I don't know whether Mandle really had got something or not. If he had, I want it."

"Too late, alas, too late." Norton nodded his head in mournful disinterest. "The stream of time has passed you by." He eyed his plate. "Thanks for the steak, anyway."

"Darn the steak!" He made the table creak as he rested brawny arms upon its rim. "What's Mandle worth? Was he regarded as an authority in his field, or just a minor noise?"

"Ferguson could tell you that. He's the science ed, and he bought the article. From what I know of Ferguson, I'd say Mandle was big enough to say things that get inscribed on tablets of stone and handed down through the ages. Fergie specializes in scientific last-words, and he's so scientific himself that he buys his likker in liters instead of quarts."

"Thought you once told me he doesn't drink?"

"Aw, you know what I mean." Norton was politely bored. "He's particular."

"Look, Bill, do me a favor, will you? I'm out of touch with all these layer-inventors and I'm beginning to regret it. Get me Ferguson's estimate of Mandle's scientic status plus the name and address of any other local boy he thinks is qualified to take up where Mandle left off."

"Anyone would think you're in danger of losing money."

"I might lose seven new and extremely expensive gadgets, including the world's only one-millimeter film

recording apparatus. Apart from other brain-children in his ship, Quinn's toting around a fifty-pound camera that'll take a tremendous footage of film in full color. It set me back twenty thousand bucks, for which I get lunar-trip projection rights. Those items represent all my headaches and half my fortune rolled into a lump." He mused a moment. "I'm gambling the lot at long odds but I sure hate to lengthen the odds unnecessarily."

Norton grinned and said: "So you want to make sure Quinn gets back with all the dingbats and the stupendous epic?"

"Of course! But quite apart from that I don't want Quinn vaporized." Armstrong was serious. "He's a screwball—as is any guy who prefers to shoot the Moon while there's still a crossing to sweep. But I like him. Even if he loses the camera and all the rest, I want him to get back with his pants unscorched."

"Nice of you!" Norton stood up, patted his stomach, sighed with pleasure. "The curse of all these rocket-ship disasters is that they occur too far out for us to get action shots of them. You couldn't persuade Quinn to bust-up somewhere handy and, say, bring down the Empire State with him?"

"If he does come down, I hope it's smack on Joe's Joint where all your bloodthirsty photogs hang out," growled Armstrong.

Norton laughed. "O.K., keep your hair on! I'll bait Fergie for you and give you a ring."

"Make it as soon as you can." Ordering a second coffee, he sipped it meditatively as Norton departed.

A coincidence too many times repeated, Mandle had declared, was not a coincidence: it was a phenomenon with a law behind it. That was logical eough. Haphazard chance had room for sequences, as any gambler knew, but hardly for sequence that long. Mandle had something there . . . but what? A law? What law? *Whose* law?

The last notion made him blink uneasily. Whose law?—how silly! Must be a remnant of the Russki complex. No *real* laws were man-made; they were products of nature, fixed, unalterable. The so-called laws of man were ethical accommodations, understandable, modifiable. Man-made edicts couldn't blow up eleven ships more than two hundred thousand miles away. Of course not. Something far outside of this world was responsible for that.

Outside of this world? What was outside? That's what the rockets were trying to discover. That's what his super-camera was intended to record. Anyway, one thing now seemed a safe bet:—new worlds harbored new laws.

Or new people operated new laws.

Or old people operated old laws!

Scowling at where his thoughts were taking him, he gulped the remainder of his coffee, left the café. He caught a mirror as he exited, paused and studied his own features. His face, big-boned, brown and muscular, framed dark gray

eyes, which regarded him steadily. Nothing abnormal there.

"My! what great big teeth you have, grandmama," he said.

The image grinned and answered back: "All the better to eat you with, my dear."

"I dream too much," he grunted. Dreaming had produced the super-camera, the solar-compass and his other ideas, but for the moment he was too disgruntled with himself to think of that. "Time I got wise to myself!"

The last lugubrious comment was prophetic, decidedly so. He didn't realize it, of course, neither did he consider that ancient crack about true words being spoken in jest. Not that anything made any difference: bull-bodied people oft are bull-headed.

Norton was the first to agitate the phone. He came on with, "According to Fergie, the late Bob Mandle was an up-and-coming astrophysicist whose speculations are as good as anyone else's. He showed me Mandle's last paper. It was full of crazy drawings and a lot of Greek to me; all about Mandle's Patterns which are supposed to modify some other nutty scrawls called Lissajous' Patterns in a way that shows why photons have weight. Pussonally, I don't care why any durned photon has weight, or even if it floats weightlessly, like a balloon. Still, Fergie seems to think it approximates to divine revelation."

"What of the other data?" Armstrong pressed.

"Oh, yes. Mandle's nearest prototype is Professor Mandle."

Armstrong gazed patiently at the screen while Norton gazed back, then he rumbled: "Say that again."

"The only local big-brain of Mandle's type and status is Professor Mandle. This phone's O.K. at my end. What's wrong at yours?"

"I heard you the first time. Quit horsing. It isn't funny."

"I'm not trying to be funny. I've more sense than to try to buck your competition." He smirked in the screen. "Fergie said anyone with enough brains to slosh around in his skull ought to know of Mandle's collaborator without being told." He smirked again. "Claire Mandle."

"A girl!"

"His sister. Her hair has square roots. If she condescends to listen to a wolf whistle, it's solely to study the Doppler effect."

"Hm-m-m," contributed Armstrong, impressed.

Norton became earnest again. "But Fergie insists she's as good an authority as was her brother, in fact the only better one he can think up is a mighty-domed old dodderer named Horowitz, who lives in Vienna. This Horowitz, affirms Fergie with enormous awe, actually weighed a photon to the one hundred twentieth place of decimals by juggling a lot of mathematics around a chlorophyll reaction—whatever that may mean. D'you know what it means?"

"Since one of my gadgets employs photosynthesis, I ought to

have a faint idea," Armstrong told him, dryly.

"Good for you! Me, I'm so ignorant I think colonization is personal hygiene. Want any more info?"

"I guess that's all I need. Thanks a lot, Bill."

"No thanks. I've paid you for the steak. When'll you be ready to buy me another?"

"I'll call you when telepathy tells me you're starving." He cut off, brooded until the instrument woke up and nagged at him again. It was the captain this time.

"The medic pronounced it cardiac thrombosis," he informed. "In real language that means a blood clot in the heart."

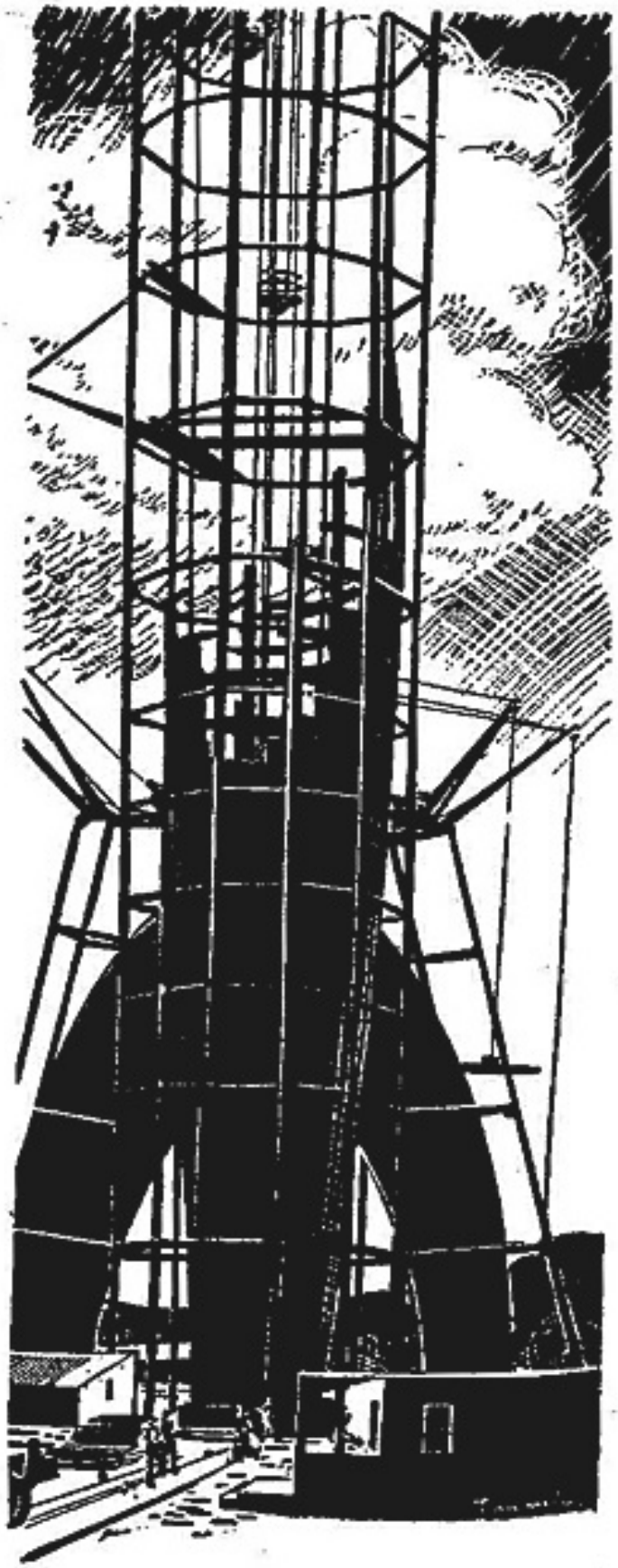
"A natural cause?"

"Of course!" The police captain showed signs of irritation. "Why not?"

"I just wondered, that's all," Armstrong soothed. "It's a case of a little knowledge being worse than none. I happen to know that blood can be made to clot by employing the diluted venom of Russell's viper. From that fact I jumped no-place."

The captain's irritation increased and he waxed officious. "If you know anything which gives you cause for suspicion, no matter how remote, it's your duty to tell us."

"All I know is that rocket-shots have a hoodoo on them. So when the first guy likely to get us some place promptly turns up his toes, it makes me wonder whether there's more to it than a mere hoodoo."



"Such as what?" the captain riposted.

"You've got me there!" Armstrong confessed. "I'm playing blind man's bluff."

"Mind you don't break your neck over a chair," the other advised.

"Not if I can help it."

After the captain had switched off, he pondered the problem of interviewing Claire Mandle. This would be a poor time to pester her, with a funeral on her hands. Better wait a bit. Better give her at least a week. That would allow plenty of time for a trip to New Mexico and a useful check-up on progress down there. Besides, the journey might help him get rid of his elusive obsession, his silly notion that rocket number eighteen would get nowhere if he left undone those things which ought to be done—without knowing what things.

He got the phone again, called the airport, booked a seat on next morning's jet plane for Santa Fe. Disregarding the car, he went out on foot for his evening meal. One could see more and think more when walking.

His choice of an eatery was careless and unfortunate. The food was good but they shot it around on an electro-skate serving system as if they were stuffing cattle in a pre-marketing fattening battery. There was a small dance floor on which, halfway through his meal, a dozen pairs commenced the latest shiver-jig to the steady, nerve-jangling thrum of six double-basses and one electric harp. The pom-ting-pom rhythm was supposed to be a tune titled "Skiddin' With My Shiver-Kid." It whumped up and down and to and fro like a mephistophelean metronome. Pop-eyed and open-mouthed, the couples clung together and shuddered from knees to head. The harp and basses skidded them into a state of near-hysteria. If they stuck it out for twenty minutes, some of them would be borne from the floor jerking and twitching like marionettes. Sonolepsy! Armstrong walked out in disgust.

Window-shopping along the road, he came to a small art show. There was one piece centered behind the glass which caught his attention, a curiously curved lump of wood faintly resembling the body of a lobster. From its upper surface projected two thin, rhodium-plated rods, one bent, the other straight. The ticket beneath it read: "Elevation Of The Psyche, by Tamari. $75.00."

His strong jaws lumped as his gray eyes lifted their gaze and caught his own reflection in the window glass. For a moment he stared at himself as if at a complete stranger.

"Who's been sleeping in *my* porridge?" wailed the teeny-weeny bear.

He stamped one foot hard as if somehow to shake off something that wasn't there, made for the nearest bank of recorder booths. Only the *Daily* booth was unoccupied, so he entered it, reclined in its easy-chair, metered his nickel, and scanned the *Daily*'s evening edition as it glowed into the screen.

There was nothing about rocket ships apart from the item stating that the Russian Government acknowledged and appreciated the many expressions of sympathy received from all countries in the world. No word of public clamor against rockets appeared. Maybe the papers were keeping it out as long as possible. National pride, if nothing else, demanded that rocket-shots persist.

The whole edition was unusually innocuous, giving most prominence to the Mississippi floods and the Wentworth murder case. Young Wentworth had been declared insane, and the *Daily* hinted that if he hadn't been young Wentworth he'd have burned. But three alienists had spouted learnedly about combative neuroses and saved his dissipated body. Elsewhere, perhaps in Balikpapan or Bungo Bungo, somebody was being hung by the neck until dead because he really was nuts. It wasn't what you did so much as where you were when you did it.

"Darn!" said Armstrong loudly. "There I go again! What the heck's up with me today?" Emerging from the booth, he diagnosed his own complaint as a disordered liver, promised himself some salts. If he'd diagnosed it as athlete's foot, or oedipus complex, or extra-sensory perception, he'd have gone no further from the truth.

"Truth is a jewel with many facets," defined Prince Gautama. But the Buddha forgot to add that the further you get from one the nearer you get to another. Armstrong didn't think of it, either. Leastways, not then!

II.

The New Mexico construction and launching site lay some fifty miles north of Gallup. From the viewpoint of those operating it the only thing to be said in its favor was that it had come cheap. Rocket number two had taken off from here twenty years ago, and when it burst in space, like a monster squib, its saddened builders had abandoned the site. Better financed, partly with government funds, the constructors of rocket number nine had taken it over, improved it, extended it, then discarded it. Now number eighteen was hoping for better luck.

Armstrong found the place strangely quiet. Laconic guards let him through the big, triple-locked steel gate and he met Quinn when halfway to the administrative block.

Looking up at him from shoulder height, Quinn said: "Hello, Shorty! What brings you here?"

"You never write to your benefactor," Armstrong pointed out.

Quinn grinned. "Benefactor my foot! Now Lawson isn't playing around with his eternal mathematics I chivvied him into calculating your rake-off. He says that if the film runs no more than ten minutes it should bring you ten million frog-skins."

"Of which the government takes seventy per cent and you get fifteen." His answering smile wiped off as he continued: "What d'you mean, Lawson's not working?

What's going on around here—is it the local saint's day?"

"All work ceased yesterday because Washington has cut the dollar flow until some question of high policy gets settled. That scared our private supporters and they followed suit. There's a trickle coming in which is sufficient to meet the weekly pay-account, but that's all. On top of this, Ribera Steel is held up by lack of beryllium for body plates." He grinned again. "Hence the siesta."

"This is tough."

"I don't agree. The longer it goes on, the longer my lease on life."

Armstrong eyed him carefully. "You don't have to go, George. You can step out of it any time you want."

"I know," Quinn's small, pugnacious face lifted as he gazed at the sky. "I was only kidding. Wild horses won't drag me out of that boat once she's flaming to go. The job's mine and nobody else's. Don't you forget it!"

"Whenever she gets completed."

"They'll finish it sometime. There are technical snags and bureaucratic obstructions which slow down the job, but it will get done eventually. I feel it in my bones."

"Well," praised Armstrong, "thank heavens for one optimist."

"It isn't that I'm optimistic at all. You felt the same way last time I saw you. Why, you told me yourself that number nine took two years and that this one's well ahead of it." He studied his listener curiously. "I'd say you've got a temporary touch of pessimism. You've got the blues. Snap out of it!"

John Armstrong mused a moment. A worker in oily denims wandered by whistling "Skiddin' With My Shiver-Kid." He heard it writhing among his thoughts, wriggling like a worm.

"Maybe you're right," he acknowledged. "I seem restless these days, and my notions shoot off at the queerest tangents."

"The reason is simple," Quinn offered with an assured air. "You worked like nohow to develop some skeezits in time for this ship. You beat your brains around until the job was done. Now you've time on your hands while your mind is still spinning. It gives you the fidgets. You ought to take up something to occupy your thinkbox, something high-pressured and healthy, such as bank robbery."

"Thanks for the advice, Dr. Quinn," he smiled. "Well, let's go bait friend Fothergill."

They stopped as they came to the part-built rocket, surveyed it silently. It posed within its surrounding framework, a dull black cylinder eighty feet high. The framework soared another eighty above it, indicative of the total height after the nose got fitted. That meant the shell was half-completed, and not much of the innards put in. There was a lot of work yet to be done, a lot of work.

Continuing on to the administrative block, they found Fothergill in

his den, a dark, dapper individual who liked flowers on his desk.

"Ah, howdy, John!" He offered a smooth, well-manicured hand. Then he signed to chairs, sat carefully in his own, primped his perfectly knotted tie, moved the flower vase an inch to one side. "Well, well, well," he said with unctuous joviality, "to what do we owe this pleasure?"

"I was bored," Armstrong informed. His stare at Fothergill was steady, unblinking.

"Indeed? Fancy that!" He fluttered his hands helplessly. "You couldn't have picked a more unfortunate time. What with supply difficulties and governmental indecision and whatnot we're all tied up. But it's only temporarily, I hope."

"What's the 'whatnot'?" inquired Armstrong, bluntly.

"Eh?"

"You mentioned 'whatnot' as one of the things tying us up."

Fothergill swallowed, looked at the flowers, then the ceiling, then the flowers again.

"Well?" Armstrong rapped. At his side, Quinn eyed him speculatively, but he disregarded it, kept his attention fixed on the other.

"Little things," said Fothergill, feebly.

"What little things? Anything which can hamstring a project as big as this can't be little. Who says they're little?"

Flushing, Fothergill sat up. "You can't talk to me like that. I don't like your attitude."

"Go easy, John," warned Quinn, anxiously.

Armstrong leaned forward, gray eyes aglow. "Why do Ribera Steel have to keep us waiting for plates when Bethlehem have got enough beryllium to sink a battleship?"

Fothergill jerked in his seat and said: "How d'you know that?"

"Because Bethlehem are soliciting beryllium armor plate orders in the advertising columns of all the trade sheets."

"Even so, I can't cancel a contract," Fothergill protested.

"I'm not suggesting that you can. But there's nothing to stop Bethlehem supplying on behalf of Ribera. It's a common trade practice. Who decided that Ribera was to have the contract, in the first place?"

"Womersley."

"Senator Womersley?" Armstrong's bushy eyebrow arched upward.

Shifting the flower vase another inch, Fothergill nodded. His expression was that of one crucified.

"Now, what about the 'whatnot'?" Armstrong persisted.

"Oh, for Pete's sake!" Fothergill's optics made vain appeal to the ceiling. "They switched the atomic fuel from plutonium to thorium on some abstruse grounds of top-velocity controllability. That didn't matter much seeing the engines aren't finished. But North American Tube were advised of it, looked into the matter, then asked to have the venturis back. They say the silicone plastic linings are no longer good enough. They'll have to be thickened or toughened somehow."

"Anything else?"

"The X-ray scanner went hay-

wire, leaving us unable to examine welding lines as they're completed. We had to order another. It hasn't come yet."

"Is that all?"

"A strike of lorry drivers held up supplies for several days, but we got it settled. We settled it by threatening to bring in a railroad spur." Fothergill was beginning to recover. He looked at his questioner. "What's up with you this time? You act like you've been appointed official progress-chaser. You got a diamond mine on the Moon?"

Armstrong stood up. His smile was large and lopsided. "It may be a case of mischief being found for idle hands to do," he said, enigmatically. "Thanks a lot for all the news—and so sorry I got in your hair."

The other's hand went up and smoothed his glossy, well-oiled pate as if to stroke Armstrong out of it. "I've got troubles enough without reciting them to all and sundry," he complained. Then he switched on his most hospitable look. "Glad to have seen you again, anyway."

Outside the block, Armstrong said to Quinn: "You're doing nothing, George, so how about giving me a hand?"

"What d'you want me to do?"

"I'd like you to snoop around and dig me up some names. Mail them to me as soon as you've got them. I want the name of the guy who's in charge of that scanner, also the one who advised changing the fuel, also the one at North American Tube who wrote in asking for the venturis back. If you can manage it, I want to find out who stirred up the lorry drivers."

George Quinn gaped at him incredulously, and said: "I think you're nuts!"

"Most of the world thinks you're a darned sight nuttier!" Armstrong retorted. He squeezed the other's arm, making him wince. "We lunatics have got to stick together."

"Oh, all right." Quinn became moody. "If you want to play Sherlock, I'll stooge along."

He patted Quinn on the back by way of approval and encouragement. We've got to stick together—pat-a-cake, pat-a-cake, baker's man.

All the purple mood crowded on him again, suddenly, heavily. It was as if some fourth-dimensional pseudopod had reached forth to compress his brain. Shoving hands deep, into his pockets, he tramped to the gate. Best to get away before Quinn's analytical stare started uncomplimentary comments. Shoo-shoo, baby!

Back in New York he settled himself in his apartment and considered matters afresh. In Connecticut he'd got as nice and compact a laboratory as any man could desire. There, many of his best hours had been spent in profitable development of some germ of an idea. It was an enticing place providing one hastened to it bursting with idea-generated enthusiasm. It was equally unenticing if one went seeking no more than refuge from the world.

At the present moment he had nothing to develop, nothing in any

scientific sense. His record stood at a dozen fruitful notions in as many years, which was good going for any free-lance experimenter. But he couldn't produce a flash of genius to order. He couldn't indulge a burst of laboratory activity without first being fired by inspiration—and such inspirations came as they chose, unforeseen, uninvited. Quinn, therefore, had made a shrewd estimate: his trouble was that he hadn't enough to keep his mind busy.

Defeated by the closure of its natural escape channels, his brain was seeking elsewhere. It was conjuring phantoms for him to chase, summoning nameless specters for him to pursue through the darkness and the night.

Reaching that dismal point of introspection, nine men out of ten would have decided to see a mental specialist or take a foreign vacation or, at least, join a golf club. Armstrong's reaction was individualistic and typical of himself. If his brain wanted to run after visions, well, let it run! It should be a harmless pursuit and possibly amusing. A change is as good as a rest. Why not try track down the imaginary dragons? Through the darkling wood might really lurch something with a breath of flame. He decided to give his obsession free rein. To him, such a personal decision verged on the irrevocable. Once made, he stuck by it stubbornly.

"Or would you rather be a mule?"

Relieved by the prospect of openly enjoying his own eccentricity, he got out the car, drove into New Jersey, called on Eddie Drake.

"Hey," exclaimed Drake, to thin air. "Look what's here! The Man-Mountain!" He made a gesture of welcome. "Take that chair—it's the strongest one in the house. How much d'you want to borrow?"

"I'll borrow a cigarette seeing you're charitably disposed." He lit up, crossed thick legs, surveyed his big shoes. "Seven years back, Eddie, you worked on rocket-ship number nine."

"Don't remind me of it," Drake mourned. "It was also flop number nine."

"That wasn't your fault."

"It wasn't anybody's fault," remarked Drake.

"You sure of that?"

Drake dropped his automatic lighter, scooped it up from the carpet, and protested: "Don't wallop me on the noggin with a sudden one like that!" He examined the lighter for damage, shoved it into his vest pocket. "Number nine went *bam!* halfway to the Moon. Everyone had made as good a job of it as he knew how. Evidently the job still wasn't good enough. Somebody's best hadn't proved sufficient. Was that his fault?"

"No, of course not. But I'm not so much interested in what happened ultimately. I'm curious about the snags you hit before that, and the nature of them."

"I see." Drake's regard was keen and understanding. "You're having trouble with number eighteen and are looking for a tip or two?"

"In a way."

"Doesn't surprise me. I'll be glad to give what help I can." He ru-

minated while his memory searched back. "Our biggest trouble was when the engines cracked. They'd proved topnotch on the test bench. They functioned beautifully at the first tryout after installment in the ship. They cracked at the second test and we had to replace them with a heavier job. That cost us five months and a lot of moola."

"Who built the engines?"

"Southern Atomics."

"D'you know who designed them?"

"I've not the remotest idea. Probably I could find out."

"I'd be obliged if you would," Armstrong told him. "Any other troubles?"

"Only minor ones."

"Remember them?"

"The auto controls had to be aligned again. Two tubes burned out on test and had to be replaced. We had a good deal of bother with local civic dignitaries who objected to a bang in their bailiwick and wanted us to go to China. The government's half-interest in the boat enabled us to fight them off."

His eyes narrowed in reminiscence as he studied Armstrong and carried on. "The biggest trouble occurred *after* the thing blew up. It took off, as you'll recall, in the full glare of world-wide publicity. Later came the premature bang. That was followed by an uproar I can still hear today. Every taxpayer, foreigner, religious crank, financial pundit or political extremist seemed to write pungent letters to the papers, to Congress, and to every individual remotely connected with the ship. A dozen guys wrote me offering to reveal who'd blown it up. Two more confessed to doing it. Ten said it was God's judgment. One mailed me his income-tax demand and invited me to pay it." He chuckled knowingly. "When number eighteen falls apart you'll soon find out who did it—they'll all write in and tell you."

"Who d'you think they'll say?"

"The Catholics, the Jews, the Negroes, the Freemasons, the Ku Klux Klan, the Salvation Army, the Veterans of the World War, Jehovah's Witnesses, the British, the Russkis, the capitalists, the anarchists, the bankers, the oil combines,"—he paused, out of breath—"and so on."

"That'll tell me a heck of a lot!"

"It'll tell you the world's chockfull of petty hates and cockeyed prejudices and warped judgments."

"Not quite full," Armstrong differed. "No, I wouldn't say it's quite full. There's calm reasoning in some places. But let's get back to what I'm after. Ed, who supplied the auto controls and the tubes?"

"Remote Engineering made the controls. North American Tube supplied the venturis."

"Hm-m-m! One more item—d'you know who started that civic agitation against you or, if not, could you find out?"

"I know," said Drake promptly. He pulled a face. "I had more than one wordy battle with him. He was Mervyn Richards, a hollow-eyed, lantern-jawed busybody from Farmington. He could talk the legs off

a running duck, and he scared the local folks plenty."

"He's not bothered us so far."

"I don't think he's likely to, either. Last I heard of him, he was in Frisco lording it over some cult which wants to boost its ectoplasmic vibrations, or some such twaddle."

"I see." Armstrong mulled things over a minute. "D'you know where Clark Marshall is these days?"

"Somewhere in Florida, I believe. Want to question him as well?"

"Yes. I'll get hold of him somehow." He got up, shook hands. "See you again, Ed. Don't forget to let me have those names."

Driving home, he stopped at a Jersey City library, spent some time searching through reference files and several books on rocketry. This gave him nine names, two of which he traced in the Manhattan telephone directory. These two he rang up and cross-examined with a persistency which brought him a shower of wisecracks and friendly abuse. But he extracted reluctant promises to co-operate, and was satisfied.

From the library, he finished the run home, dumped the car, made a written record of all he'd got to that moment. Then he read it through, weighed its worth. Not so much. Just a lot of meaningless stuff. However, there was more to come in as Quinn, Norton, Drake and the others dug up data.

Even if it did get completed, the jig saw might not present an intelligible picture, and it was a certainty that he couldn't concoct as much as a suggestion of a picture out of these few pieces. He'd have to do a lot more loping around and, in the end, was more than likely to find himself with a crazy pattern compounded of bits of a dozen pictures. Still, as a time-passing occupation it was better than chalking slogans on walls. "Vote for Moriarty." Not likely!

What next? There would be the other seven names to chase on the morrow and perhaps the day after, too. After that, the time should be ripe to interview Claire Mandle. Thinking over all possible sources of information, it suddenly struck him that there was nothing to prevent him going the whole hog. If he was determined to practice systematic lunacy, he might as well be thorough about it.

Extracting his typewriter from its case, he hammered it heavily, made up several air-mail letters, four for Britain, three for France. They were clear, cogent, and invited assistance, but he wasn't sanguine about them. Urgency tends to dissolve with distance. Petty troubles look considerably pettier from three or four thousand miles away. Maybe the Europeans would come back with data, maybe they wouldn't, but it was worth a try.

Taking the letters out on his habitual think-walk, he mailed them, strolled downtown. Electric signs winked and blinked and glowed at him from every angle: "Rose Bourbon," "Perlitz's Snackery," "Vitalax Will Give You Life," "Taxi

Dance," "Kit Rooney in 'The Luck of the Irish,'" "Vitalax," "Gildé Brau," "Vitalax," "Vitalax." Persuasion, invitation, insinuation, repetition, repetition, repetition. A fundamental truth is anything proclaimed often enough to be believed. God is love. Rah-rah for good old Rutgers. Peace—it's wonderful. All the news that's fit to print. What's meant by "fit" and who says so? Vitalax will give you life. Strong arms will protect the peace. All the news . . . Vitalax—

Unconsciously he must have spoken aloud, for a passer-by stopped, stared at him, and said: "I beg your pardon?"

"Nothing," he assured. "I was chatting to Twillip." The other looked puzzled, and he explained: "He's tiny and green and wears a knot in his tail. I keep him in my vest pocket." He grinned, showing his teeth..

"Oh!" The pedestrian became vaguely frightened, gave him a peculiar glance, hurried on his way.

Turning into a nearby snackbar, Armstrong picked a corner table, ordered a pint of extra-strong java. He nursed his head in his hands while waiting for it. There ought to have been little blue bubbles expanding in his brain and steadily going *plop-plop-plop*. The queerest part of it was that there weren't any bubbles. His brain felt fit and fat and full of sin. He didn't want to play with feathers and treacle, neither had he any desire to fill his shoes with butter.

The coffee came, he sipped it, watched the passing crowd. The blaze of light from the windows lit them up like actors on a stage. Cold faces, hot faces, long faces, squat faces, snappy faces, happy faces, dark faces, fair faces, smug faces, bare faces, blubber faces, rubber faces—and none of the lot alike. Yet they all rotated around an elusive norm. And that norm was the keystone of democracy.

What democracy? Lincoln's? Lenin's? King George's? The democracy of Robespierre? Of Confucius? Oh, anything from the companionship of misery to the airy enlightenment of the Duc de Morny who didn't mind the people so long as they didn't come at him downwind. They'd all got it in some shape or form, in mode as variegated as themselves.

An attendant back of the counter switched on the radio and the Philharmonic Orchestra oozed forth with Handel's "Largo." It was soothing. It snored out with a slow, majestic beat that cleared away the mental blurs like the metronomic sweep of a windshield wiper. It killed the Shiver-Kid, and poured all the Vitalax down the drain, and lent grace to the stream of faces.

Then the music faded out, a cold, precise voice took its place. "Newsflash! A major disaster occurred half an hour ago in the Ural Mountains where Russia's largest atomic fuel plant is located. The shock of the explosion registered on all the world's seismographs and it is feared that the death roll is heavy. Further news will be broadcast as it comes in." He paused, added: "This comes to you by courtesy of

Gildé Brau, the better beer." He departed. The "Largo" drifted back. It sounded different now; a dreary dirge.

With a muttered imprecation, Armstrong left the place, joined the throng outside. Darkness was now complete and all the firmament was sable save where the Moon leered down like a great white eye. There was a continual flow of powerful, fast-moving lights along the whole length of the Manhattan Skyway and far up into the Bronx. Somewhere between the light-stream and the Moon, high atop an invisible building, a crimson worm crawled slowly and formed words:

SHE WILL LOVE
CHICLEMINT

Behind him, the radio in the snackbar changed stations and blared with enhanced volume. Someone started to croon a song called "Mudder Shudder Wump" while a hot band beat 'em down into their boots.

"Then suddenly they knew that they had died, hearing this music mock their shadow land." Armstrong couldn't remember whence he had got the words, nor could he imagine why they had popped into his head. But they unsettled him. Grabbing a passing taxi, he raced away from the scene, a fugitive from he knew not what.

Seven wasn't such a lucky number. He got up from a sound, untroubled sleep which contrasted strangely with his daytime meemies, showered, shaved, switched on the morning's *Herald* recording. The Russians had announced that fifty square miles of land surface had been desiccated and that the central pit was nearly two miles deep. Cause unknown. Number of dead unknown. The Society of Friends had offered twenty air-ambulances and were rushing them in from the Chinese border. Young Wentworth had sold the movie rights of his life story.

Savagely he switched off the recording, spent the rest of the day tracking down the seven. Two, he learned, were dead. One was in Europe, whereabouts uncertain. Three he reached on the phone, found one of them lightheartedly willing to humor him, the other two surly, impatient, scornful and at no pains to conceal their opinion that he was a crank. To the last one, the seventh, he mailed a letter. That was that. Until fresh items turned up he'd exhausted all lines of approach, excepting Claire Mandle.

Mid-morning of the following day he motored to Tarrytown, following the last line. Claire Mandle proved to be small, dark-haired, pert-featured, and quite unlike her brother. She wore an expensively tailored suit of myrtle-green corduroy, her hair-do was precise, and she bore herself with quiet self-confidence. Looking at her, Armstrong decided that her most attractive feature was her eyes; they were dark and slightly tip-tilted, giving her an elfin appearance.

She sat at ease on an antique wheelback chair, her hands resting in her lap, and listened as he spoke.

"Then your brother had just got to the point of enlarging his suggestion when . . . it happened." He brooded for a few seconds. "I felt I couldn't very well bother you about it before now."

Her finely arched brows rose a fraction. "You think I might be able to give you the information you've missed?"

"I have been assured that you're about the only one competent to do so."

"Bob and I worked together, but not entirely," she said thoughtfully. "We had separate interests, too. I'm afraid I'd have to look through his papers and give the matter some thought before I could offer you a worth-while opinion."

"I'd be grateful if you'd do just that," he assured.

"Can I phone you?"

"Of course." He fixed her with gray eyes as calm as her own. "But I'd prefer to see you in person. Say, in town. We could discuss things over lunch."

She released a low tinkle of laughter. "You don't let the moments run idly by."

"I have an ulterior motive," he told her.

"Really?" She was femininely curious. "What is it?"

"I'd like to show you to a newshawk friend of mine. He told me that your hair has square roots."

Her laughter was the same as before, soft and low. "Very well. I am quite willing to demonstrate the truth, if it will upset a newsman." Her look reminded him of a pixie peeping around a larder door, liquid-eyed, a little amazed. "I'll phone you when I'm ready."

"Bless you!" he said, conscious of the gruffness of his voice.

Back in the car, he started the engine, got well out of earshot before he performed an underbreath yodel. Brother, it pays to be nuts. Look where it gets you! *She will love Chiclenuts!* He clipped his yuralayetee off in mid-song, glowered at the windshield, did the rest of the journey in silence.

Quinn shiver-jigged the phone in the afternoon, gave him four names. "Here they are, Sherlock, and much good may they do you." In the screen he squinted violently and protruded his tongue. "Lookit me! This is what you'll be like in a week's time."

"What's supposed to happen in a week's time?"

"Nothing. That's why you're going to look like this."

Armstrong emitted a disdainful grunt. Carefully he noted the names on his scratch pad, then asked: "Anything doing down there yet?"

"We've started a local chess tournament."

"What, are they still held up?"

"Held up ain't the words for it. Senator Carmichael has sonorously enunciated the total number of greenbacks spent on Moon shots to date. Also the number yet to be spent. He says it's all a darned shame. Senators Wright, Embleton and Lindle joined in and chorused that it's a shame. They're still talking about it."

A copy of "Runbaken's Political



Zoo" was among the tomes on his shelf. Getting it down, he read the profiles of Senators Carmichael, Wright, Embleton and Lindle. Then he remembered Womersley, looked up that worthy's also. It didn't get him anywhere; that is to say, he didn't find the feature for which he was looking. The profiles' slick phrases and diplomatic adulation were plastered over the usual successful-business-executive and poor-farmboy-makes-good stories. The five men differed in quite ordinary ways, agreed in quite ordinary ways. On the face of it, they were nondescript. What he was after, if it could be found, was some strange or unusual or peculiarly significant feature which they shared in common. For all that the *Zoo* book revealed, what they shared in common was the habit of wearing pants.

The most foolish feature of his will-o'-the-wisp hunt after imaginary and perhaps nonexistent rocket-busters was, he suspected, that he was conducting it practically single-handed and without adequate facilities. He was trying to outdo the F.B.I., and with less on the ball. But the hunt itself wasn't foolish, not to his experimental mind. He'd run after phantasms before and had found them astonishingly solid-looking at the end of the chase. When, by one of those rare, Edisonian accidents, a midnight stroke of lightning super-gausses an iridium-cobalt needle which promptly stands perpendicular to Earth's magnetic field and drifts slowly from right to left, and when you spend two years pursuing the phenomenon until you can nail it down and tag it a solar compass, well, by that time you've

developed a hound-dog nose for any curious odor. Thus he compounded with his eccentricity and rationalized it in familiar terms of research. The argument was a welcome prop for his mind; he never did like his mind being shoved around until it stumbled.

The next logical step was to peel a few off the wad and buy an extra brain or two. When you're having fun, you must expect to pay for it, and should the fun turn deadly—a dark and vicious game of stab—!

III.

Hansen was a likely ally; his reputation was good, by all accounts. It took Armstrong only a short time to drive uptown to the brownstone block on the second floor of which was Hansen's Agency. There, a tall, languid blonde took his card, disappeared for a minute.

Presently she came back with: "Mr. Hansen will see you now, Mr. Armstrong."

Hansen himself proved to be a hard party almost as tall as his client but not as beefy. Giving Armstrong a chair, he sat erect behind his desk, his sharp optics taking in the other from head to feet. The examination was slow, deliberate and unconcealed.

"Summarizing?" smiled Armstrong.

Without dropping his scrutiny or changing expression, Hansen inquired: "What can I do for you, Mr. Armstrong?"

"I want an accurate report on several people." Pulling the list from his pocket, he handed it over. "Those people."

Hansen scanned it. "Five of these are senators."

"Does it matter?"

The gimlet eyes went over him again. "It all depends upon what sort of a report you have in mind. If you want their conventional life-stories, O.K.! But if you want material for a smear, I must know exactly who you are and what sort of a smear it's going to be. If I don't like it, I won't take it." His thin lips clamped shut, opened again. "That's the way I do business."

"And a very proper way," Armstrong approved. "Evidently you don't know me. If you doubt my motives, the solution is a very simple one—all you need do is put another name at the head of that list."

"What name?"

"John J. Armstrong."

"Yeah," Hansen agreed. "That's good enough." His right hand fiddled with the gold signet ring shining on his left, twisting it round and round. "Say more."

"I don't want an expensive book-length report on each of those individuals. I'm not interested in their birthdays, bathnights or blonde troubles. All I do want, as fully and completely as possible, is data on organizations to which they belong, businesses, clubs, brotherhoods, fraternities, political, religious or ethical bodies, or any other puddles in which they may be jumping frogs."

"That'll be easy," Hansen commented.

"Then it ought to come cheap."

He smiled broadly as the other flinched. "The more thoroughly you can do it, the better it'll be for future business."

"Oh," said Hansen, poking the list. "This isn't all?"

"No—that's just the beginning. You'll have another list before long, and another one after that. If my money and patience last out, and if none of my friends subject me to a mercy-killing in the interim, I may want you to investigate a battalion."

"We'll do our best. I'm sure you'll be satisfied." He played the ring again. "It'll cost you forty each to get us going. All extras above that will be detailed in full on the bill. No major expense will be faced without first consulting you."

"For which heaven be thanked!" remarked Armstrong, with fervent humor. He handed over the money.

Pressing the stud on his desk, Hansen said to the blonde when she appeared, "Put this lettuce in the safe, Miriam, and give Mr. Armstrong a receipt."

The car took it slowly back to the *Herald* while he lounged behind the steering wheel and called a mental roll of the troops. On the professional side he'd now got Hansen and whatever cohorts he commanded. The volunteers, willing or merely obliging, consisted of Norton, Drake, Quinn and several others—to which he might be able to add The Pixie. It wasn't bad going seeing that none of them knew just what they were doing, himself included. It wasn't such good going considering the huge, world-wide organizations of people who'd no better idea of what they were doing. But, of course, from orthodox viewpoint it is not of any importance that one should be going somewhere; it is enough only to think that one is doing so, or imagine it, or believe it. Or be persuaded of it.

Norton was busy when he reached the *Herald*, and he had to wait awhile. They gave him the visitors' lounge to himself, a large room furnished with garish opulence and littered with recent recorder copies printed on paper. Idly, he looked through them.

The first copy got him on the stumble again. Page seven announced that "Airways Eat Up Distance" while page ten showed lurid pictures of the Iowa City airmail crash in which were fifty dead. The distance to the grave! He ripped the page over. "Vitalax" . . . "the Coolskin Hour" . . . "Gildé Brau" . . . "Ivory Tower Gloss Contains Benadium, The Wonder Polish For Your Teeth." Benadium—common baking powder. Why didn't they call it bolonium? Don't you know? Silly man! Toora-loora-loora, hush, now don't you cry!

Whup! went the page as he whisked it over. "The Four Freedoms." "Mercer Indicts Arcadia In Able Speech." "Kuomingtang Condemns Mongol Hordes." "Greek Protest" "Copper Shares Scramble." "Thought For Today . . . Thought For Today—" he blinked and read it, tiny letters in a little box.

"Verily, verily, I say unto you, what shall it profit a man though he

gain the whole world and lose his own soul?"

Just then Norton bounced in yelping cheerfully, "Boy, have I got a telepathic appetite!" He stopped, stared, added in more sober tone: "What's up with you, Misery?"

"I can't make out why my dander takes switchback, rides over my brain-crenellations," said Armstrong, slowly. "If I shouted the reactions I get in this dump, I'd be put down as a red-hot radical. If I bawled them in Herald Square, I'd be lynched as a fascist. I think the real trouble is that I ought never to have crawled out of the lab."

"Nope," Norton contradicted. "You've got the same trouble as yon Cassius—you think too much." Dexterously, he topped it with, "And don't eat enough, in company."

"All right. I can take a hint. Where d'you want to guzzle this time?"

Norton shuddered. "Need you be so coarse?"

"I talk to suit the local atmosphere."

"Let's get out of it then. Let's try Papazoglous' dump—he's got a new way with steaks, so I'm told."

Going out together, they took the car to the Fiftieth Street subterranean car-park and left it there. A short walk of two blocks brought them to the Greek's place, a modest eatery full of warm kitchen smells. The new way with steaks proved to be gobbets of meat sandwiched around mushrooms and roasted on a spit. Norton, as usual, worked his way through a load of it as if he'd been hungry for thirty years.

Finally, he said, "A-a-a-ah!" and lay back. He gave Armstrong a dull, surfeited eye. "O.K. Now you've got me helpless and incapable of rising, you can shoot the works. What d'you want me to do this time, while I'm still too weak to refuse?"

"Clark Marshall seems to have disappeared. Eddie Drake thought he was down in Florida, but I've not been able to trace him. I thought maybe some of your Floridian newshawk pals might be able to get a line on him. He was in Key West a few days ago."

"Sure it's not a copper job?"

"I can't go crying to the police without just cause for suspecting that something's happened to him. As far as I know, he's packed up and ambled on in his usual aimless way. But he's a newsworthy character, and probably one of your fellow steak-killers has gone the rounds with him and knows where he is."

"Yes, he's newsworthy all right - or was! He grabbed the headlines three times with rockets numbers one, ten and fourteen." Norton shook his head sadly. "Poor old Clark! He sure went to pieces when the last one busted." His look at the other was distant, reflective. "You never met him, did you?"

Armstrong shrugged and said, "I've only seen his photo and read some of his old articles. I also read his letter to the papers in which he prophesied that number eighteen was doomed in advance. I reckon

disappointment has soured him a lot."

"It more than soured him. It got him scatty."

"In what way?"

"I dunno exactly. Let's say he developed a sort of persecution complex. Yeah, that's about it. He took on the fixed expression of an early Christian martyr and started to shift around, first here, then there, tomorrow some place else. As if he was running from something."

"Or chasing something?"

With difficulty, Norton sat up. "Now look here, I don't mind you pursuing Irish phoonigans and getting me to run after them with you—with occasional pauses for steak. But don't add to your delusions the notion that Clark Marshall and paint-drummers and bigamists, and everyone else who dodges around, are all pounding steadily along with you, going where you're going, looking for whatever you're seeking. Don't think the whole tomfool world is solidly behind you." He flopped back, exhausted. "Because it ain't!"

Armstrong said: "I am aware of the fact. I am also aware that the world is not solidly behind anything."

Tangling his fingers in his lap to form a sling for his distended stomach, Norton let his mind struggle with that last remark. "Cheesecake?" he murmured. "No—some people object to it. Peace? Nope! If nations don't larrup nations—which at present they don't—then families larrup families and guys larrup guys." He closed his eyes. "And sometimes they larrup dolls, just for the ducks of it." He opened his eyes. "Eats," he pronounced pontifically. "The world is solidly behind its fodder. All the world eats—it has to."

"Except when it fasts or goes on hunger-strike."

"Darn!" ejaculated Norton, tiredly.

"It fasts for religious reasons, hunger-strikes for political reasons, and sometimes destroys food for economic ones."

"Go on, rub it in! All right, we'll agree that the world isn't solidly behind anything. Do you know why?"

"Do you?"

"Sure I do. Everyone in my line of business knows why, and so do a good many more. It's because the world is stupid."

"I wouldn't say that," Armstrong opined.

"I would." He gave the stomach a comfortable, satisfying hitch upward. "You've incarcerated yourself too long to know how all-fired stupid it is. Why, a few years back one of our guys asked a hundred people the name of President Jackson's mother. Forty-seven correctly replied, 'Mrs. Jackson.' Fifty-three said they didn't know or couldn't remember." His glance at his listener was self-satisfied and cynical. "Last year, two hundred thousand Russkis paraded past Lenin's Tomb as if it were God's hiding-place. About the same time, Frenchmen started tattooing their ear lobes with three dots for liberty, equality and fraternity. The year before, when the King of Siam broke his leg, his entire court stumped around on

crutches because royalty had set the fashion. There was one period when most of the British aristocracy wore snakeskin suspenders for the same reason."

"Maybe, but—"

"Lemme go on," insisted Norton, beginning to enjoy himself. "By the time you've been twenty years in my game you'll realize that nothing's too crazy to be impossible. Have you ever read Pitkin's 'A Brief Introduction To The History Of Human Stupidity'?"

"I can't say I have."

"Believe me, the governing word is 'brief.' Pitkin and his sons and grandsons couldn't live long enough to write the whole of it! The marathon dancers and peanut pushers and flagpole squatters of your childhood were all centuries behind the times. Stupidity goes back, way back to the dawn of history. Why, the Pyramids are such mighty lumps of stupidity that stupid people have been evolving stupid theories about them ever since."

"Perhaps so, but—"

"For the love of Japhet," complained Norton, "will you let me get a word in edgewise? The degrees of stupidity are varying. For instance, I think I'm pretty clever because I've encountered plenty of people a good deal more stupid than myself. But it's only a relative cleverness. Really, I'm stupid too, though not so utterly and completely as some dumbclucks. Similarly, there are people in the world with sufficient glimmerings of intelligence to perceive the greater stupidity of their fellows and take advantage of it. If they can get hold of the law they use it to throw a cloak of legality over their machinations, and thus become politicians. Or they get under the cover of some convenient, ready-made law and become journalists, patent medicine vendors, armaments makers, crystal gazers—or even rocket shooters. Some will go so far as to operate outside their fellow racketeers' laws, which makes them lawless or, in other words, crooks." He smiled dreamily. "It is an ancient adage that Nature made crooks to educate fools."

"Have you finished?" inquired Armstrong politely.

"Yes." He gave his stomach another hitch, wriggled it pleasurably. "It's the steak. It makes me supinely bellicose."

"Well, then," Armstrong continued, "it seems to me that your reasoning is topsy-turvy: you start with effects and work your way back to an assumed cause."

"Assumed?"

"Certainly. How d'you know it's stupidity?"

"If it isn't stupidity, what *is* it?"

"I don't know."

"There you are, see?" Norton was triumphant. "You don't know!"

"What of it? Does my ignorance prove anything?"

"No, it doesn't prove anything," he admitted reluctantly, "but it leaves my theory standing alone, with no competition: the theory that the world is, and always has been, and probably always will be hope-

lessly stupid. No other notion fits in so well with the facts."

"I can think of ten," Armstrong told him. "And they all fit better!" He stood up, facing the other's look of dumfounded surprise. "As you remarked, the trouble is that I think too much." He picked up his hat. "If you're not too stupefied to remember, see if you can get a line on Marshall for me." He waved a big hand. "So long, Gutsy."

"Pleasant fellah!" Norton called after him, loudly. Glooming at his empty plate, he licked his lips, suddenly became gloomier still. "Oh, suffering snakes, he's left me with the check!"

It took Hansen five days to dig up the details. From Armstrong's viewpoint, this was speed, and his estimate of the tough, lanky agent went up six notches.

Opening out the neatly typed report which Hansen had mailed, he went carefully through it, murmuring its phrases as he scanned them.

"Irwin James Lindle, partner in Reed-Lindle Autobinder Company, of Wichita, Kansas. Member of the Senate Catering Committee, and the Latin Relations Committee. Belongs to the Association of Farm Machinery Manufacturers, the National Association of Manufacturers . . . um . . . um . . . Second Avenue Episcopal Chapel of Wichita, International Rotary, Kansan Bowling Union, Post 414 of the American Legion, Sharpshooters' Club . . . um . . . patron of American Youth Movement's Wichita Hostel . . . um . . ."

There was a lot of it. Hansen had done the job thoroughly. Armstrong counted the items after he'd perused them, found that Lindle belonged to no less than thirty-eight organizations of one sort or another. On the next sheet, Womersley beat the score with a total of fifty-four. Embleton went down to twenty-nine. Marking each report with its appropriate score, he found Womersley's fifty-four at the top, while Mervyn Richards held the bottom with a mere eleven.

Anyway, this lot was far from sufficient. He needed the reports on Quinn's list of names which he'd received and passed on to Hansen the day before. He also needed the information yet to come from Norton, Drake and the others. It was sheer waste of time to fiddle around with only one-tenth of the puzzle. One had to have many more pieces to gain some clew to the picture, to deduce what bits were missing and, perhaps, where they were concealed.

He gave it up as the phone shrilled. Claire Mandle's face swam into the screen when he switched on.

"Good afternoon, Mr. Armstrong!"

"Good afternoon, Claire," he responded with bold enthusiasm. "When do we dine?"

"My!" she chided. "Have I kept you waiting?"

"About a week," he pointed out.

"I'm sorry. I didn't think the date was so urgent."

"Of course you didn't. Modesty becomes you!" He favored her with a mock glare. "But now that the waiting period is over, and you've

satisfied yourself that my intentions are honorable—"

"Oh, so you have intentions?" she interrupted mischievously.

It caught him off-balance. He screwed up his face while he walloped his wits into submission. The way her tip-tilted eyes watched his performance added nothing to his comfort.

"I told you of them," he said, feebly. "I wanted you for an exhibit."

She smiled and carefully stabbed him again. "Where do you wish me to make an exhibition of myself?"

"You pick the most awful words," he complained. "How about Longchamps?"

"This evening?"

"Oh, boy!" he yelped.

"Tut!" she reproved. "That isn't at all scientific of you."

"Have you had a look at yourself?" he shot back.

"I was not referring to your appearance. I meant your behavior."

"Oh, that!" His grin was broad. "That was designed to prove that action and reaction aren't equal and opposite."

"We can discuss the point later," she said. "Eight-thirty at Longchamps. Will that suit you?"

"I'll be there." For some queer reason his voice seemed high and squeaky, and when he pulled it down it dropped into his boots. "At eight-twenty—just in case you're early."

She was not early, but she was prompt. A taxi dropped her outside the main door at exactly eight-thirty, and he met her, conducted her inside, found her a seat. Under her fur coat she was wearing a frock of shimmering green stuff, and her faultless hairdo was topped by an object too small for a hat, too big for a flower.

Noticing his fascinated gaze fixed on the top-piece, she informed, "It's just a finisher-off."

"I'll say!" he indorsed, with total lack of tact.

With a slight frown, and a delicate nibble at her bottom lip, she switched the subject. "I've looked through Bob's papers."

He dragged his eyes down, said: "What did you find?"

"He'd made a systematic collection of data on the eleven ships which exploded fairly near to the Moon, such as their distance from the satellite at the time they blew up, and the last instrument-readings radioed back. The evidence he assembled makes one thing seem certain: they didn't disrupt because of fortuitous appearance of different causes in the same area. The disasters had a common cause."

"This layer of his?"

She hesitated. "Maybe." Her elfin eyes grew troubled. "One of those ships developed an off-swing, probably due to the burning-out of a side venturi. Its observed path curved a great deal before the gravigyros turned it straight. The result was that it approached the satellite's eastward limb and got a couple of thousand miles nearer than did any of the others. Then it blew apart."

"And so?"

"So that fact bothered Bob con-

siderably. It created the only flaw in his layer theory, which can't be reconciled with a two-thousand mile plunge before disruption. He stewed it over, found himself faced with two conclusions. If the data on this boat wasn't accurate, and if in actuality it had exploded at about the same distance from the lunar surface as had the others, then his theory was O.K. But if the data was correct,"—she paused doubtfully—"it looked very much as if that ship had been beamed out of existence."

"What," he exclaimed, "from here, a couple of hundred thousand miles away?"

"Obviously not. There is no disruptive beam of that efficiency on this planet, as far as I know. In fact, I can't see how it would be possible to make a beam with one per cent of the required efficiency." She pondered a moment. "The alternative is a beam from Luna, which is said to be airless, devoid of any sign of life. The notion is so patently absurd that it's hardly worth considering. That leaves only Bob's layer theory, which is faulty if all the data is correct."

They ceased conversation as a waiter brought them their order, resumed when he had gone beyond hearing.

Armstrong told her, "All this mystery about what's causing it is due to lack of data at this end. The ships have radioed back a lot of stuff, temperature, cosmiray-count, fuel consumption, lunar gravity pull, and so forth, but it's not been enough." She nodded in response to his glance, and he went on, "How're we going to dig up the extra information? Have you got any ideas?"

"A convoy might get it."

"A convoy?"

"Yes—and the more ships, the merrier." She sipped her drink delicately. "A manned mother-ship controlling several auto-jobs running in echelon ahead of it. The leader should be the decoy duck. When it bangs, its follower curves off short, radioing data. If that one proves to have skidded too near and likewise goes kerplonk, the third ship curves away. Meanwhile, the mother-ship, lagging well to the rear, turns for Earth at the first blast, picking up all the data it can get from the others as it retreats." She twiddled her glass around on the white cloth, her eyes meditative. "Even if that technique fails to bring in enough information, it will, at least, settle one point."

"Such as which?"

"It'll settle whether they're being beamed or sabotaged in some remote way. If they're being sabotaged, then no fast getaways will save them. But if only one makes safe return, then the cause may be assumed to be a layer."

"Easy, so easy," he mourned. "It won't cost more than a mere couple of hundred million dollars."

"Yes, I know." She was genuinely sympathetic. "But since the required details are a couple of hundred thousand miles away, I suppose someone will have to spend a thousand per mile to get them. There

doesn't seem to be any other way." Her pert features brightened and she gave him an encouraging smile. "I can lend you ten, for a start."

"Thanks, but I don't think I'll need them," he told her. "If a couple of hundred million smackers were wanted for the purpose of blowing up most of civilization, they'd be found in short order. But not for a project like this, oh, no! Ten million for a battleship: ten cents for astronautical research—that's the way the world wags."

Her cool hand rested gently on his big paw. "Moody man!" She smiled again as he fidgeted restlessly. "It's not that the world's sense of values is wrong, you know!"

"No?"

"Not at all. It's quite natural that money should be found for war more easily than for adventure. After all, fear is an emotion deeper, ghastlier than any other. Insurance against fear is so much more imperative than is satisfaction of curiosity. Nobody's home will be preserved, nobody's life saved or freedom secured by conquest of the Moon."

"Freedom," he scoffed. "What atrocities are committed in thy name!" He fidgeted again, his heavy jowls lumping muscularly. "It all depends on what is meant by freedom." Then he changed tone and added. "Pardon me—we didn't come here to argue with each other, did we? Let's get away from the subject."

"All right." Gazing around, she surveyed the people at neighboring tables. "Where's the newshawk who was supposed to look me over?"

"He won't be along. I changed my mind and didn't call him."

"How come?"

He tried to leer at her, but hadn't the features for it. The resulting grimace sent her eyebrows up. "Two's company," he informed.

"And that horrible face you just pulled was supposed to express menace?"

"If you like. I guess I'm no durned good at putting on an act."

"Do you think it necessary?"

He warmed to her, and assured, "Of course not! I was trying to run away from my earlier thoughts and I ran too far. Like someone who laughs heartily after a dental extraction, just to show he didn't feel it."

"The masculine mind is strange indeed and tortuous are its ways," she quoted philosophically. Idly her glance went over his shoulder. Her eyes sharpened, she leaned forward and spoke in low voice. "My brother Bob had one bee in his bonnet. Maybe he told you of it. He suspected coincidences."

"Yes, he mentioned it. Why bring it up now?"

"It just occurred to me." Her trim head came still nearer. "Four tables behind you is a sandy-haired, freckle-faced man in a light gray suit. He was strolling past my house this morning when I went out. I looked at him quite casually, of course, and would have forgotten him except that he crossed the end of the road when I started out this evening. Now he's here. Three

times in one day—how's that for coincidence?" She chuckled softly. "If he's half as nosey as Bob was, and notices me, he'll think I've got designs on him."

"You're sure that it's the same fellow?" asked Armstrong, without looking around.

"I'm positive."

"And you've never noticed him before today?"

"Not that I can recall."

He pondered it a moment, then shrugged. "Your timid admirer," he hazarded, "worshiping you from afar."

"Don't be silly," she reproved.

He shrugged again, consulted his watch. "Will you excuse me a moment? I'll be back very soon." He got up as she nodded, strolled casually to the entrance, still without looking around.

Outside was a phone booth. Stepping into it, he slipped it a nickel, watched an ipsophone dial grow into his screen.

Mechanically, the ipsophone enunciated, "Hansen's Agency! You may switch to night-line at the stroke of four or record your message at the stroke of ten. One . . . two . . . three . . . four—"

"Switch!" snapped Armstrong.

A small blue light began to wink steadily at point four on the distant dial, while to the listener's ears came the persistent *brrr-brrr-brrr* of the calling-tone.

Followed a sharp click, the ipsophone-dial faded out, was replaced by Hansen's dour features. The agent had his hat on. He looked expressionlessly at his caller, saying nothing.

"Going out or coming in?" inquired Armstrong.

"Going out. It makes no difference. The line gets answered whether I'm here or not." He stared bleakly from the screen. "What's the matter?"

"I'm at Longchamps with a lady friend. Maybe she's being tailed."

"What of it? There's no law against tailing someone, especially a dame."

"How about loitering with intent to commit a felony?"

"Bunk!" Hansen's eyes glittered in his dead pan. "You've been reading the wrong books. If the guy has no criminal record, it won't hold water. You can't get him until he cuts your throat."

"All right." Armstrong grew pugnacious. "I don't spend nickels on you for nothing. Sing me a lullaby."

"You can drop him by doing some fast skipping around."

"Skipping's a girl's game."

"Or," Hansen continued, disregarding the crack, "you can lure him some place nice and quiet and systematically kick him in the teeth."

"I've thought of that. It doesn't tell me anything."

"Or," Hansen went on, as imperturbably as ever, "you can do what I'd do—tail the tailer and find who's back of him. I like to know the score."

"That was my idea. Since I'm staying with the lady, I can't track a guy who's tracking her—especially



while I've got her on my mind. This is where you come in."

Hansen said: "Can you stay put until I get there?"

"Sure. We were going to the Television Exhibition on Sixth, but we can stick around until you're with us."

"Give me fifteen minutes." He shoved his hat backward on his head. "When you see me, you don't see me—get it?"

"I don't know you from Adam," indorsed Armstrong. Cutting off, he saw the screen fade out, went back to Claire.

She was dabbing her face with a handkerchief little larger than a postage stamp and her upward glance was bright as he reached her table.

Seating himself heavily, he complained, "That fourth table is not occupied."

"Goodness me!" she exclaimed, openly surprised. "Are you thinking of that man? Why, you're as bad as Bob!" Sobered by his calm, level gaze, she added: "He went out right after you."

Waving the subject aside, he summoned a waiter. Best to dismiss the matter. Let her settle down and be happy for the necessary fifteen minutes. But who was Sandy-hair after now, Claire, or himself?

Only one minute late, Hansen arrived in company with Miriam and a squat plug-ugly whose jacket creaked across his back. The trio paraded loftily past Armstrong, looked at him as if he were a pane of glass, took a table far over to his left.

Chatting to Claire, and keeping one eye open for the still absent tail, Armstrong gave the arrivals time to deal with a round of drinks, then got up, helped his companion on with her coat.

They made it to the exhibition, spent a couple of hours mooning over the imposing collection of stereoscopic jobs and watching a demonstration by a rural traveling model with a ten-foot screen mounted on a truck. Full colors and stereoscopy didn't leave much further room for improvement, they agreed. Television, as such, was mighty near the limit of development.

From there, he took her to a midnight snackery, then got out his car and ran her home. Nothing untoward happened and by the time he'd reached his apartment he'd seen no sign of Hansen's company or of any other shadow. Feeling disgruntled about the unexpected nor-

mality of events, he wondered whether he was afflicted with an infantile tendency to over-dramatize mere incidentals.

Looking backward deep into his childhood memory, it did not seem that he'd been in any way abnormal. His active mind had been no more active than that of any other healthy child, his fancies no more fanciful, his excitements no more unreasoning. It was only of late that he'd developed his peculiar obsessions and dark suspicions. Why, why, why? He glowered at the wall which silently echoed: "Why, why, why?"

With the dawn and later in the morning he was still thinking it over, and the echo still lingered. Restless and disturbed, he mooched around the apartment until Hansen called him on the phone at ten-thirty.

"I've been in the business a long time," Hansen announced, "but this is the first occasion on which I've ambled around with a cavalcade like last night's."

"What d'you mean, a cavalcade?"

"There was you and your girl friend. There was a guy tailing you. After hanging behind him for an hour I suddenly discovered someone was hanging behind me. So I switched with Pete and thus dropped this last snooper. He stuck to Pete, being unimaginative. I joined behind him. That made you, then your tail, then Pete, then the other guy, then me. Good job you didn't decide to make a night of it—you'd have been leading half of New York around by now."

Armstrong frowned. This recital puzzled him completely. "What happened?"

"The first tail dropped you when you got home. He went to the subpark on Eighth, dug out a car, took it to this address in Cypress Hills." He read out the address, then continued, "Of course, the rest of the parade reached Cypress Hills, at which point Pete threw it up and went home. Pete's tail then followed him but got dropped halfway. Miriam had to put in some circus antics with our car to help Pete get rid of him. That left this last tail and me, and I stuck to him. Ten guesses won't tell you where he led me."

"Where?" Armstrong demanded.

"Fourth floor of Bank of Manhattan. He took the night elevator up by himself, as if he owned the place. I couldn't follow him any further."

"D'you know who's on the fourth floor?"

For the first time, Hansen's lean face took on an expression; a queer mixture of dissatisfaction with the revelation he was about to make, and satisfaction with the anticipated effect upon his listener.

"I watched the elevator indicator. It stopped at the fourth floor. I looked outside, saw lights on the fourth floor." He paused tantalizingly. "The entire fourth floor happens to be the local headquarters of the F.B.I."

"What?" Armstrong bawled.

"You heard me." Hansen went

dead pan again. "So I reckon I'm entitled to know what this is all about, and what I'm being dragged into."

"How the heck do I know?" For once, Armstrong felt lost for words.

"If you really don't know," suggested Hansen, with grim skepticism, "you'd better go round and ask the F.B.I." Giving the other a hard stare, he cut off.

Armstrong sat down and nursed his head. It'll settle whether they're being beamed or sabotaged in some remote way. Skipping's a girl's game. Vitalax will give you life—or will it? Better go round and ask the F.B.I. Strong arms will maintain the peace. Fifty square miles with a crater two miles deep. I am Ozymandias, the king of kings—gaze on my works, ye mighty, and despair! Gildé Brau . . . Vitalax . . . better go round and ask the F.B.I.

Better go round and ask the F.B.I!

IV.

The F.B.I. man had the widest and boniest features Armstrong had ever seen. He looked like a wrestling champ with sartorial tastes. Sitting solidly behind his ebony-topped desk, he propped his visitor's card against a small calendar, studied the other with cool, slightly greenish eyes.

"What is your trouble, Mr. Armstrong?"

"I'm dragging someone around. He's a member of your mob. I want to know why."

"Of course you do!" The F.B.I. man smiled faintly. "We hoped you'd come here after Hansen tipped you."

Armstrong rocked back in his chair, and said sharply: "How d'you know Hansen tipped me?"

"Our man reported that Hansen had followed him most of the evening and finally trailed him here. He made no attempt to drop him, since Hansen is quite well known to us." He smiled again. "And doubtlessly he gained some mild amusement in leading your agent to this place."

"Ugh!" growled Armstrong, disgustedly.

"However," the other continued, "I can tell you that you've nothing to worry about as far as we're concerned. You acquired a tail solely because we're keeping a fatherly eye on Miss Mandle."

"Then why the hope that I'd come here?"

"Because your coming would prove that you've not the slightest notion why you were followed. That, in turn, would prove that you don't know why we are interested in Miss Mandle." He gazed absently at the calendar. "Have you told her about last night's episode?"

"No, I haven't."

"Is she aware that she was followed?"

"I don't think so. She came near to suspecting it but put it down as coincidence." Armstrong began to feel a little irritated. The mystery of his own making was threatening to become a mystery of considerably wider scope. "Just why are you keeping an eye on her, anyway? Of what do you suspect her?"

Blandly ignoring the questions, the other eyed him keenly and inquired, "Were you quite satisfied with the way in which she dismissed her momentary suspicion as coincidence? You don't think she was putting on an act? Did her manner convince you as natural and innocent, or was she in any way apprehensive?"

Armstrong answered: "Anyone could see with half an eye that the last thing she'd dream of was being shadowed. She'd no reason to be followed. Why should anyone trail around with her?"

"Why do you trail around with her?" the F.B.I. man thrust.

"That's my business," he snorted.

"Quite! And this is ours!" The federal agent stood up, legs braced apart. "All I am able to tell you is that we're keen to discover whether Miss Mandle is aware of a particular fact which we'd rather she did not know. Also whether—if she does know it—she is passing it to anyone else. What you have told me suggests that she does not possess the information in which we're interested."

"Why not ask her in a straightforward manner?"

"Because Miss Mandle, having a scientific mind, could not be questioned without perceiving the significance of the questions. She would, I am afraid, be swift to deduce the very truth we wish to keep from her."

"Then this information is of a scientific nature?"

"You may draw that conclusion, if you wish." Picking up Armstrong's card, he handed it back. It was a polite gesture of dismissal.

Armstrong got up, stuck the card in his vest pocket. "Has it anything to do with Moon rockets?"

The F.B.I. man did not bat an eyelid. "I am sorry, I'm quite unable to give you any indication at the present time."

"Supposing I tell her that the F.B.I. has got her tagged?"

"We would much rather that you didn't. But we can't compel you to say nothing." The federal agent studied him levelly. "We may be satisfied and drop our interest in her pretty soon. But if you chip in, we'll treat it as a hostile act and keep a tag on you, too. Please yourself—it's up to you."

"Oh, heck!" Armstrong was puzzled and far from pleased. "You talk in riddles and tell me nothing. At least, you might say why that guy from Cypress Hills also shadowed us."

The other frowned. "That's something we've yet to discover. If Hansen's doing his job, you'll probably get the reason as soon as we shall."

"All right." Armstrong walked hard-heeled to the door. "We'll leave it at this."

"Sorry we can't tell you more," the agent called as he swung the door behind him.

Reaching the street, Armstrong wended his moody way to the nearest phone booth, called Hansen, told him in detail of what had occurred. "So," he finished, "they're tagging Miss Mandle in case she discovers

that Santa Claus is only her father and starts a revolution among disillusioned kids."

"You mental deadbeat," said Hansen politely.

"What?" He blinked, glared at the agent's impassve face in the little screen.

"That fat Fed told you plenty."

"Did he now, Bigbrain? What did he tell me?"

"One, they can't ask questions in case Miss Mandle mulls them over and sees the light. Two, that means they don't suspect her of getting the facts by her own astuteness. Three, that tells you they think she may have got hold of them in some other way. Four, that suggests they think she may have been told by somebody known to have been in possession of the information."

"Go on," Armstrong encouraged.

"For some reason, they can't check up on whoever might have told her. Why can't they? Answer: because he's dead. O.K.! What person now dead might have been so close to her that he'd blab something he shouldn't ought to?"

"Bob Mandle."

"However did you guess?" Hansen's dark eyes stared from the screen, steady, unwinking. "Bob Mandle had some officially provided information which he was supposed to keep to himself. No doubt it concerned something in which he was directly involved, and in which his sister was not involved. Maybe another Manhattan Project. Maybe the government is trying to make a wavicle-bomb some place. I dunno. Darned if I care, either, so long as I can keep this business in the clear."

"You're in the clear, you needn't worry about that," Armstrong assured.

"No need to tell me. I rang up the F.B.I. before you got there. They said they'd nothing against you." He looked down at his desk, not visible in the screen. "I've three more reports just come in. Will you pick them up, or d'you want me to mail them?"

"Mail them," Armstrong ordered. Cutting off, he went to his car, got in, but did not start the engine. For some minutes he sat in the driving seat and pondered the problem. He had a faraway expression as he stared through the windshield and let his mind wrestle with the facts.

Suppose he contacted Claire and asked her flatly how come—what then? Anyway, how could he ask her? "Have you got any official information which you should not possess?" Darned silly, that! "Did Bob ever tell you anything he shouldn't have done and, if so, what was it?" Hey-hey, that would get him shown the door in double-quick time!

If she were ignorant of whatever she was suspected of knowing, his questions would be resented no matter how tactfully put, and all he'd get for his pains would be a negative response. On the other hand, if Bob had passed her something strictly in brotherly confidence she wasn't likely to hand it over to a comparative stranger at the first asking. He'd still get a negative

response. Definitely, cross-examination of Claire Mandle was out. He immediately dismissed it from his mind.

How, then, to dig out the cause of the F.B.I's interest? It wasn't that he was unduly inquisitive about something which was no business of his, but rather that he was obsessed with an irresistible feeling that here was a missing piece belonging to his own peculiar puzzle. It might be a key piece. If he could get hold of it, an entire corner of the picture might appear.

The matter needed further stewing, since it was evident that he was not going to get at the truth in any direct way. What Claire Mandle was not supposed to know was also something which he was not supposed to know, and if the F.B.I. wouldn't tell him anything it was a safe bet that no other bureaucrat would confide in him.

Temporarily, he released the problem from his thoughts, decided to visit a newsreel theater and give his overactive imagination a rest. Taking the car uptown, he parked it, went into the Fiftieth Street Newsflash.

Blinking in the semidarkness, he found his way to a seat, sat down, cast a jaundiced eye at the screen. Glowing in full colors, the brilliant oblong depicted the North Dakotan gallows wedding which many of that morning's news-records had criticized as being in the worst of taste.

There, swinging side by side from a pair of scaffolds, the bride and groom hung with the fateful nooses around their chests and under their arms. A goatee-bearded justice of the peace, similarly suspended, muttered his way through the prescribed formula while the bethrothed couple smirked inanely at the camera.

Edging uneasily in his seat, Armstrong scowled at the picture. Obligingly, the scene changed. Indian riots, this time. Moslems charging a Hindu procession, and police armed with lathis beating up both. Close-up shots of sweating, fanatical faces, of bodies sprawling in the gutters. A brief glimpse of a burning temple with its ages-old walls collapsing around the smoke-obscured figure of the Great God Ganesha.

Next, the launching of the *Iron Duke*, Britain's latest and biggest battleship. Bang went a bottle, up went a flag, and a horse-faced individual saluted to distant strains of martial music. Strong arms will protect the peace. Then the first flight of Russia's new five-hundred-ton bomber. Cheers, more music, and the shot of a column of marching feet. Strong arms will protect the peace. After that, the picture of a tiny, shapeless dot racing at tremendous speed across the fuzzy horizon; America's two-thousand-miles-an-hour stratosphere fighter. Glory, glory, hallelujah! Strong arms will protect the peace.

Followed a swift whirl of new fashions in hats, frocks and swim suits, then some useless gadgets from a trade exhibition. The program settled down to a eulogy of the latest juke box, with press-button changes, a twelve by twelve

screen depicting the appropriate performers, and adjustable focus to pick out individual instrumentalists. Get an eyeful of this: Runny Runbaken's Runnerbeans playing "Skiddin' With My Shiver-Kid." It's solid, sister, eight beats to the bar. C'mon, slip me some skin and let's beat 'em down a bit. Stab button two and it'll really send you. Hep-hep!

His eyes now accustomed to the half-light, Armstrong looked sidewise, studied the faded blonde sitting next to him. Her jaws were working rhythmically, her eyes fastened to the screen with a sort of dull intensity, her left foot tapping in time to the blaring juke box. Introductory stage of sonolepsy.

Averting his gaze, he transferred it to the opposite side, found there a vapid youth, his mouth hanging open, his eyes bugging straight ahead, his well-padded shoulders twitching to the same crazy beat.

Bang 'em for a zulu,
Slam 'em for a lulu:
Riddin' all the rhythm rats,
Skiddin' — skiddin' with my shiver-kid!

Nudging him with a heavy elbow, Armstrong snapped, "Poostermoolies!"

The vapid one gave a violent start, ceased his twitching, turned his popping optics to the other. "Eh?"

"Poostermoolies," growled Armstrong, standing up.

"Oh, sure!" The youth drew in his legs to let Armstrong pass. After the brawny figure had gone, the youth returned his attention to the screen, his mouth hung open again, never a thought about what poostermoolies might mean entered his mind. As Armstrong had known, any word would have done to obtain the required reaction.

Armstrong went home. Something deep in his brain was curling and contorting like a mutilated snake. It was a weird and worrying evasiveness which he couldn't pin down, a nagging thought which recurred at the most unexpected times. Whenever it got him bothered, his technique was always the same: first he tried to identify it then, failing, he tried to get rid of it.

What enabled him to lose it this time was the sight of the tiny pinhead glowing like an insect's eye in the center panel of his door. Standing before the door, key in hand, he examined the fluorescent speck, then looked swiftly up and down the landing. Without touching the door, he pocketed his key, stole silently away.

Outside on the sidewalk he glanced up at the windows of his apartment, noticed that they were in darkness. Crossing the road, he went to the corner drugstore, phoned Hansen.

"I've got an ant-eye cathode ray tube buried in my door. It lights up if the door is opened by any means other than a special nonconducting key. It's alight now. Somebody's in there."

"Call the cops," Hansen suggested.

"That was my first thought, but

now I've got a better idea. I want you to phone my apartment. If anyone answers, tell them it's the hourly police-check and demand to see me. If they've got the scanner covered when they answer, tell them the same and order them to uncover it." He grinned belligerently. "That should send them out on the run. I'll be behind to see where they run to."

"O.K.," Hansen agreed. "I'd like to know what all this is about, but I'll do it." He cut off.

With a casual air, Armstrong mooched out of the drugstore, made his way along the street, slipped into a dark doorway almost facing his apartment. His wait proved longer than expected. Fifteen minutes crawled by, then twenty. Nobody came out of the place, nobody went in. His impatience mounted. Darn it, had the invaders seen through the bluff? If so, it could only be because they knew Hansen by sight. That was a CLEW, of a sort.

He glanced frequently at his watch while waiting for results. The vigil had lasted twenty-two minutes when a couple of cars suddenly swung into the street, raced along it, stopped before the doorway he was watching. Four uniformed cops tumbled out of the first machine. Hansen emerged from the second, looked searchingly up and down the street.

Coming out from his hiding place, Armstrong crossed the road. "What went wrong?"

"I phoned three times," Hansen told him, "and could get no reply. Neither could I get hold of you again. So I called the cops."

"Humph!"

"I thought maybe by this time you'd bulled your way in and got bopped, so I brought along some muscle. Come on, let's see what's doing."

The sextette marched up to the inner door on the panel of which the tiny telltale still glowed. Inserting his key, Armstrong eased the lock, flung the door wide. A beefy cop promptly shoved him aside, got through ahead of him, gun in hand, his other hand feeling for the light switch. The lights went up. The cop took four paces, stopped and ejaculated, "By cripes, a stiff!"

Pressing through behind him, the others had a look. The entire apartment was an unholy mess. Cupboards and drawers stood open, their contents scattered over the floor. Loose papers fluttered in the breeze through the door. Even the carpets had been torn up and tossed to one side.

In the middle of this litter a corpse reposed in an armchair, its leisurely sprawl being in eerie contrast with the general upset around it. The body's attitude was one of careless indifference, there was no blood visible upon it, indeed nothing to indicate that it lacked life except that its head lolled forward upon its chest.

Putting one hairy hand under the cadaver's chin, the leading cop lifted it gently and revealed its face. "Dead, all right!" He ran his gaze

over the others. "Anyone know him?"

Frowning at the lean, blue-jowled features and the thick, tousled hair of the corpse, Armstrong said: "I'm not positive about it, never having seen him in person, but I think he's a guy named Clark Marshall."

"The rocket nut?" Hansen put in quickly.

Armstrong nodded. "If you'll call Bill Norton of the *Herald* and give him an eyeful over the phone, he might identify him—he knew Marshall well."

Trying the phone, the cop jiggled it repeatedly, then put it down with, "Out of action. Disconnected some place." His eye was professional as it went over the disarray. "Whoever did this was in a heck of a hurry." He shrugged, said to the other officers, O.K. I'll go down to the car and call the homicide boys. I'll tell them to pick up this Norton." He went out.

One of his fellows said to Armstrong: "Generally speaking, prowlers don't bump and bumpers don't prowl. Looks like you've had both here, for once. Any idea of what they were after? If so, you'd better look and see whether they got it."

"I've not the remotest notion of what they were seeking," Armstrong confessed. By his side, Hansen smiled and emitted an exaggerated yawn. Turning to the skeptical agent, he went on, "It's a fact. I've not the slightest idea of what they were after." He paused, added with vicious satisfaction, "But, with luck, I'll soon know who did it."

"Your confidence in me is most flattering," said Hansen.

"Modesty, thy name is Hansen," he scoffed. "If I leaned solely on other guys, I'd never get any place, even though they do hold my dough. I wasn't thinking of you, nor of the police. What was on my mind was the main stem of the wall clock."

"Oh." A little disconcerted, Hansen went to the big timepiece fixed to the farther wall. Now that he was close to it, he could see that its stem was thicker than usual and that something lenslike gleamed within its cap. But for the other's remark, he realized, he could have gone over that room a hundred times and never noticed this feature. He licked his thin lips in anticipation.

While the three cops looked on in unconcealed surprise, and the corpse reposed languidly in its chair, Armstrong gently pulled the clock outward until something behind it emitted a sharp, metallic click. He then turned it round and around, as if unscrewing it, got it free from its fastenings, laid it face upward on the table. Examining it curiously, Hansen noted that its stem was now an empty tube; he could see right through it.

Working at the wall-cavity formerly concealed by the clock, Armstrong carefully disconnected several wires, drew out a small, silvery instrument fronted with a thin, lens-capped tube. This he put on the table beside the clock.

"Inside that," he told them, "is seven hundred feet of one millimeter

talking film. It may have been exposed. Whatever works that telltale on the door should start this going as well. We'll get it developed. If the gods are with us, this affair is in the bag."

"Boyoboyoboy!" whispered one of the cops, then added even more reverently, "Oh, boy!"

He started on the job immediately, and was still at it when the homicide crew poured in with Norton. The latter came at him excitedly.

"It's Clark, sure 'nuff! For Pete's sake!—I was talking to him earlier in the day."

"Were you?" Dexterously he clipped the developed magazine to the fixing tank, commenced winding it through. "Did he say he was coming around here?"

"I sent him round here. I got in touch with him yesterday, told him that you'd gone just as daffy as he was and that you wanted to see him, as one loony to another. He turned up this morning. I tried to phone you about six times to tell you that he was in town."

"I was out. I spent most of my time at F.B.I. headquarters."

"He was like a cat on hot bricks," Norton went on. "Restless and leery. He acted like he was haunted by his grandfather's ghost. In the end, I gave him your address and he said he'd look you up later today." Norton ran a hand through his untidy hair. "I didn't think he was naming his death spot!"

With an eye on his watch, Armstrong kept the tank rotating. "What d'you mean, he was restless and leery? Did he behave as if in danger of his life?"

"Well, no, I wouldn't say that. He was more like a guy who expects to be strapped in a straitjacket the first time he blows his nose. He seemed like he was nursing something he'd rather not have known, something decidedly frustrating." Norton peered at the tank. "What the blazes are you doing—making butter?"

"I hope so. I'm trying to grease the skids under someone!"

A police captain lumbered in, edging Norton to one side. "Are you John J. Armstrong?"

"That's me."

"The medic says that guy's been dead about three to four hours. Cause unknown—but we'll find it later." He stared at the tank which Armstrong was still revolving. "Where were you between three and four hours ago?"

"At F.B.I. headquarters."

"Huh?" The captain jerked as if given a mild shock. "If the Feds have an interest in this case, I'd better give them a ring pronto."

"It would be just as well," Armstrong indorsed. Pulling the film's dummy end from the tank, he inserted it into the electric dryer, began to wind it through. He winked at Norton as the captain went out.

Hansen stuck his head through the doorway. "How long?"

"Five minutes."

"I've rolled down the screen and connected the projector."

"Thanks." Still winding, he heard the phone ring in the next room, said phlegmatically to Norton,

"Looks like they've managed to reconnect it. Bet you that's Mrs. Saunders calling from Hartford to say there's hell to pay. You go take the call and tell her not to worry."

As Norton turned to go, a cop entered and announced, "The phone's O.K. now. There's a caller on who says she's been trying to get through for hours, a Mrs. Saunders, ringing from Hartford. She says your laboratory has been broken into and it's in a deuce of a state. She's got the Hartford police there now."

Norton gaped at the cop, then at Armstrong, then back at the cop. He swallowed hard. "Dump me in the den and call me Daniel!" he said to the cop. Then he made for the phone.

Reeling through the last of the film, Armstrong spoke to the openly mystified police officer. "He's taking that call. I guessed that the lab would have been tossed around, after seeing the mess here. Not likely that they'd give one place the works and overlook the other." Sliding a random section of the film into the microreader, he stared through its convex glass viewplate, whistled between his teeth. "Verily, the trap was sprung!"

Taking the evidence into the other room, he threaded it into the projector. There were now five uniformed bulls in the room, plus four plainclothes ones and Hansen and Norton. The latter finished soothing Mrs. Saunders, slammed down the phone.

"She says the whole place is upside-down, and she doesn't know what's missing, if anything."

Armstrong grunted, switched off the lights, switched on the projector. Its brilliant beam cut sharply across the room, lit up the little screen on the opposite wall. A tiny picture of the room, three feet by two, appeared on the screen. It showed the door slowly opening.

A man slipped cautiously through the door, closed it behind him, made certain that it was properly fastened before he gave the room a swift appraisal. Of medium height and build, he was sandy-haired and wore a gray suit.

"The guy from Cypress Hills," breathed Hansen, poking Armstrong in the hip.

Crossing to the small oak bureau at the left-hand side of the door, Sandy-hair deftly forced it open, went through its contents as if he had not a second to spare. Papers and documents were ripped out, scanned hastily, thrown down at random. Evidently he did not find the mysterious item for which he was seeking. With the bureau empty, he raked it for hidden drawers, tapped it on all sides, upended it and examined its base. Satisfied that nothing more could possibly be concealed within it, he turned his attention to the duralumin writing desk, dealt with it at the same frantic speed. He had no luck there, either.

For a moment, he paused and faced the little lens hidden in the clock. His pale blue eyes stared directly into the camera without showing any suspicion of the thing's

betraying watch. His face was alert, calculating, and contained a hint of impatience.

With renewed energy, he set to, removed all books from the bookshelves, shaking them thoroughly one by one, examining the empty spaces thus left on the wall. From there, he turned his attention to the chairs and settee, upending them, tapping them all over. A few ornaments were scrutinized, the carpets torn up, and he got down on hands and knees to study the floorboards beneath.

Dissatisfied, he disappeared into the bedroom at left, removing himself from range of the lens. Though he had gone off the screen, the film continued to reproduce the noises of his moving around and the occasional shift of furniture as he gave it a going-over. This continued for a couple of minutes, at the end of which someone rapped heavily on the door.

Sandy-hair reappeared. With quick, catlike step, he approached the door, stood warily at one side of it, his pale eyes on the lock, one ear close to the jamb. From his pocket he extracted an object resembling a small, brightly plated torch, and this he held ready in his right hand.

The invisible caller knocked again. Sandy-hair waited without moving. A pause, then a third knock. For about three minutes Sandy-hair stood there, his eyes and ears alert, the torchlike object still in his grip. Then the film ran out. Armstrong upped the lights.

"Jeepers!" wailed the police captain. "If only there had been more footage!"



"That was the punk we traced to Cypress Hills," Hansen asserted. He looked gloomily at the body which had been moved to the settee and which reposed there under a sheet. "Pity you couldn't pick up the scene after he came in. I wonder what happened."

"Ten to one, he didn't go away, as that sandy guy thought he would," hazarded the captain. "He knocked three times, gave it up, wandered off for a paper or cigarettes or something, came back in short time, sat down outside the door and waited for Armstrong to return. So when this sandy-haired snooper opened the door to go out, the waiting guy had him red-handed. What happened after that is anyone's guess, but this sandy guy is the one we want." He eyed Hansen. "You know where he lives, eh?"

"I know where I followed him to the other evening." He gave the address in Cypress Hills. "The Feds followed him there, too. May-

be they know where to pick him up."

"We'll see about that." The captain turned to Armstrong. "You'll have to hand over this film of yours —it's essential evidence. Momma, what sweet evidence it is!" His beefy features were admiring. "As nice a trap as I've seen in a naughty lifetime. I congratulate you on it. Pity you hadn't another one like it at your place in Hartford."

"There is another one. I'll tend to it directly you've finished with me here."

"Then you can get on the job right now. I'm durned if I see any reason to detain you."

"O.K." Feeling in one pocket, Armstrong found his door key, gave it to Hansen. "Lock up for me, will you? I'll call at your office immediately I get back." His attention shifted to the police captain. "If the Feds turn up, you'll have to do the explaining."

With a nod to the unseeing Norton, who by now was hurriedly scribbling data on a pad about the late Clark Marshall, he went out, got into his car.

His driving was very fast without being furious. His thoughts were mixed but not muddled. His gray eyes steadily watched the road ahead with a casualness which belied his alertness; now and again, briefly and without expression, the eyes flickered over the rear-view mirror, then returned to the streaming road.

He had been running little more than an hour when he reached the roundabout where five roads converged. This was as good a spot as any. Disregarding a heavy lorry thundering in from his right, and putting a sudden strain on the brakes of two sedans speeding in from the leftward road, he whirled his big machine right around the circle, regained the road from which he'd just emerged. There, he swung his car sidewise across the path of the green tourer which had been following him for the last half hour.

Swift as this tactic had been, the green tourer's driver was not disconcerted. Finding his path so suddenly blocked by Armstrong's automobile, and the other half of the road occupied by the oncoming lorry, he braked in the nick of time, stopped within a yard of the obstruction, rammed into reverse gear, backed in a half-turn.

He made the turn all right, his rear wheels well over the verge, but as he again switched gear to go forward, Armstrong reached the driver's door, jerked it open, grabbed the sandy-haired man's left arm.

V.

Like many of his buffalo-build, Armstrong seldom realized his own strength. He snatched Sandy-hair out of the car as if the fellow were a rag doll. His huge fist slammed Sandy-hair straight in the pan. The victim soared a couple of yards and went out like a light. It was as easy as that.

Mildly surprised that one of his haymakers should prove so slumbersome, he licked his knuckles, looked around, discovered that he had an audience. The lorry had

stopped fifty yards down the road, its driver leaning far out of his cab and gaping back curiously. One of the two sedans had pulled up on the farther side of the road, and from it an immensely fat woman and a load of kids were giving him bug-eyes as if he'd done it for the movies. A long, racy-lined black limousine was easing to a stop behind his own stalled machine, and the two men therein were making to get out.

Finding a handkerchief, Armstrong rolled the unconscious Sandy-hair onto his face, got his hands behind him, prepared to tie his wrists together. The pair from the car reached him, studied the scene with quiet interest. Both were big and burly, though not quite as big as Armstrong himself. One of them put out a foot, nudged the reclining captive.

"You beat us to it, Mr. Armstrong," remarked one of the pair. He flashed a gold badge in the palm of his hand. "We're federal officers." He gazed thoughtfully at the recumbent form. "We picked him up immediately he picked you up. It's unfortunate that you bopped him, though. Might have been better if you'd let him string along—he'd have gained enough string to tie himself up."

"You're somewhat behind the times," said Armstrong, curtly. "He's tied up already. He's wanted by the police."

"Oh, well, in that case you've done a mighty neat piece of work," the other acknowledged. "We could have grabbed him ourselves, only they don't always remember to tell us these things." He pulled out a set of handcuffs. "Leave him to us—we'll take him in for you."

"I'd be very much obliged to you," pronounced Armstrong, carefully, "were it not for the fact that I dislike the way your ears stick out."

With that, he smacked the other in the teeth. The kick of a stung horse might have been milder. The fellow laid flat with a spine-tingling thump.

Armstrong ducked coincidentally with the thump. The fat woman, who was still watching open-mouthed, must have credited him with eyes in the back of his head, for the striken one's companion swiped his blackjack through thin air, stumbled, half-fell over Armstrong's broad back and promptly was tip-tossed the rest of the way to ground. Armstrong made a dive for the first one now struggling to rise, and his heavy foot trod on the second one's stomach as he jumped. It was accidental but at least would serve to keep him prostrate a while.

Sheer speed, unusual in so large and heavy a man, had brought him swift victory but now proved his undoing. As he pounced upon the one striving to rise, Sandy-hair came suddenly to life, stuck out an intervening leg at precisely the right moment. Armstrong tripped, went down with a weighty wallop.

Breathlessly, he rolled onto his back, heard the fat woman emit a queer, high-pitched yelp. Somebody snatched at his feet. There came a short glimpse of pale blue eyes

staring into his own, then his noggin seemed to explode. An unknown comet arrived in the depths of his brain before all faded to utter blackness.

His senses crept back slowly and reluctantly while he lay flat on his back in the grass, with a rising lump on his cranium. A dull, pulsating ache registered painfully at the backs of his eyes. Blinking to clear his vision, he saw the lorry driver and a motorcycle cop bending over him. He sat up, nursed his throbbing head, looked around. The fat woman's sedan had disappeared, as also had the machines of Sandy-hair and the other two. His own car had been straightened up and a police motorcycle stood behind it.

"Ugh!" he grunted, fondling his head tenderly.

"Them three guys slugged you and beat it," the lorry driver informed. He looked apologetic. "They did it so quick and got out so fast that I wasn't able to get their numbers."

"My buddy's after them, anyway," put in the cop. "We came along a minute later, so maybe we'll be able to put the bee on them yet." He eyed Armstrong with an air of official speculation. "Maybe you can identify them?"

"I don't know them at all—or not yet!" Armstrong replied lugubriously. Struggling erect, he held his head to stop it splitting in halves. "Two of them tried to kid me they were federal agents detailed to follow me around. Looks like they were really an escort for the third guy."

"How did you know they weren't feds?"

"I've never heard of F.B.I. boys tearing around in foreign sports models or using European-type cuffs."

"There goes another charge," mused the cop. "It's a serious one; impersonating a law officer. I'll have to make a report in any case. Give me your name and address." Turning to the lorry driver, he added, "Yours, too—you're a witness." Having noted the details, he said to Armstrong, "How far are you going?"

"To Hartford."

"It's out of the bailiwick, but who cares? I'll tag along. If someone's laying for you they're liable to try again."

Sliding into his driving seat, Armstrong started off, the police motorcycle hammering steadily behind. Driving wasn't so good with one's head bulging like a toy balloon at every stroke of the pulse. His aching eyes strained at the windshield and he felt more than soured on himself. It hadn't proved so smart a move after all, grabbing Sandy-hair like that. All he'd got out of it was a knob on the pate.

Or was that all? Come to think of it, there was one item he didn't possess yesterday—he had the sound assurance that his seemingly eccentric search for pieces of a seemingly imaginary puzzle was no longer either pointless or senseless. Somewhere there was a picture of some sort if only he could build it up, if

only he could find and assemble the various pieces. His home and his laboratory had not been searched in a spirit of good, clean fun. He had not been tailed by Sandy-hair—and said elusive person had not been dragging a rescue party—merely to lend verisimilitude to crackpot notions. Behind all this was a purpose, a motive that might be made manifest if he persisted in his fad long enough and had a small measure of luck. Dark the purpose might be, and perhaps deadly, but *it was there!*

These thoughts soothed him so much that he arrived in Hartford in much better spirits. The motorcycle cop dropped him with a double toot on his horn and zoomed back foi his own territory. Mrs. Saunders met him, wringing her hands nervously and assuring him that she'd gone out for only a couple of hours. "And this is what happens immediately me back's turned." Easing her agitated mind with a few words, he extracted the hidden camera from its lair, processed the film, ran it through the projector.

What he got was very similar to the scene recorded on the other film except that here the searcher proved to be a thin, sunken-cheeked individual who raced through his task without being disturbed by any knocker on the door.

Two Hartford plainclothesmen arrived and he ran the film again for their benefit. But neither of them recognized Hollowcheeks. They departed with the evidence, after which he tidied the lab, checked its contents, decided that nothing of any importance was missing. Everything suggested that both searchers had failed to find the mysterious object they were seeking. What were they looking for? Was it something he carried on his person? If so, he'd better watch out!

It was three days before Hansen saw him again. The languid Miriam showed him into Hansen's office where he sat restlessly in a squeaking chair.

"I'm dumfounded by the speed at which we get no place," announced Armstrong tiredly.

Hansen frowned, fished inside his desk, found the key to Armstrong's apartment, tossed it across. "Whenever I get somewhere it's because I know where I'm going. How the blazes d'you expect me to make progress when I'm working in the dark? All you want are reports, reports, and more reports, except occasionally when you scream for help."

"Too bad," Armstrong sympathized. "I wouldn't keep you in the dark if I could see any light myself."

"D'you seriously mean to tell me you're barging around like a drunken hippopotamus without knowing what it's all about?"

"Certainly I don't know! I wish to heck I did!"

"Ye gods!" Hansen was incredulous. "You push your nose into places, and dumps promptly get torn apart and people get slugged and others get bumped—and you don't know the score!"

"Look, all that happened was that

I got a bee in my bonnet. The rest just naturally came along."

"Natch," said Hansen. "Some day a meat-wagon will come along." He frowned at his listener. "You will be in it." His frown grew deeper. "And nobody will know why." He leaned on his desk and scowled. "Neither will anyone know who's next."

"You've made a point there," Armstrong admitted. "It would be nice to know who's got to wait his turn while I get buried." A bright thought struck him, and he added enthusiastically, "Why, Hanny, it might be you!"

"I have not overlooked the possibility," said Hansen, grimly.

"Besides," Armstrong went on, "if I kick the bucket, people ought to know why I kicked it. The knowledge might persuade someone to take up where I left off. Then he'll get bumped and I'll have a friend in the hereafter."

"My business is confined to this earthly sphere," Hansen informed, stiffly. "Astral planes don't interest me unless they pay hard, solid, mundane cash."

"All right." Armstrong waved a hairy paw in bored dismissal. "I'll tell you what little I know, and a fat lot of good will it do you. I got the idea that repeated rocket failures were too many for accident or coincidence. Maybe there's something deliberate about them. Maybe somebody's doing it."

"Who?"

Armstrong favored him with a look of scorn. "Why the devil d'you think I'm jouncing around like a caged monkey if I know that?" He waited, but Hansen said nothing, so he went on. "That was a premise I adopted mostly for my own amusement, or for some other reason I'm quite unable to explain. If that premise is wrong, all my conclusions will be wrong no matter how logically I proceed from one to the other. Let me say again, I took as my premise that rocket failures are being arranged by persons unknown. What's the logical consequence of that?"

"Go on—it's your talk."

"The failures belong to different times, different experimental groups and different countries. Ergo, even a superbly clever crank could not be responsible for the lot. That, in turn, suggests an organization which, since its sabotage is so widespread, must be truly international and quite without any patriotisms. This is where the first snag comes in." He rubbed his broad chin in thought. "Those Russkis might like to prevent us reaching the Moon ahead of them; the French similarly would like to delay the British; and so with practically every country you can think up—but why should any international organization want to stop anyone getting there no matter who it is? What do they gain by that? Where's their motive?"

"Search me," said Hansen, shrugging.

"I don't see the sense of it," Armstrong admitted, "and this lack of motive is the main thing which has got me bothered. A week ago, I

could conceive two solutions: firstly, that they're selling their services to each country in turn, in which case they'd have been found out for a gang of double-crossers by now. Or, secondly, that I'm nuts and am imagining things." He rubbed his head vigorously. "However, I didn't imagine this cracked skull."

"Maybe you're digging for something that doesn't exist and unwittingly unearthing something else," suggested Hansen. "Like the guy who started digging for water and got up a corpse."

"Possible, but not probable." He mused a moment. "All the same, if there is an organization in existence, the technique is to look for it among all possible suspects, and expect it to be in some innocuous guise. That's why I'm keeping you busy with reports. I want to rake the suspects for a common denominator."

"Ah!" commented Hansen, his eyes sparkling, and again, "Ah!"

"Trouble is that I've not yet got enough reports and that complications keep catching up on me. Did you get any British and French letters, by air mail?"

Hansen extracted four from a drawer. "Sorry, I should have given them to you right away. They came yesterday afternoon." He twisted his signet ring around and around while contemplating the other. "I take it you now want reports on the eleven guys mentioned in those letters?"

"Yes, sure!" Armstrong finished reading the last one, handed them back. "Well, a few of them responded. It was more than I expected. You've only got to say, 'Boo!' to some people to make 'em clam up." Shoving his hands deep down into his pockets, he stretched out his legs, and sighed. "All I need is the butt of a monogrammed cigarette from the scene of each crime and a dramatic showdown with the guy who smokes them. That's what happens in the movies." He gloomed pessimistically at his listener. "Have you ever proved that crime doesn't pay with the aid of a monogrammed butt?"

"Things don't happen that way," scoffed Hansen. "Or not while I'm around. I have to swim my way through a sea of sweat—but I get there just the same, eventually."

"That's the hell of it. Everytime we think we're getting somewhere, we find we're getting nowhere. Sandy-hair disappears, along with his rescuers and nobody's seen a hair of them since. The Cypress Hills address proves to be a rented apartment stripped of all clews. Nobody can get a line on the punk who raked my laboratory. Clark Marshall dies of cardiac thrombosis, just like Bob Mandle, and all the medical experts tell me to think nothing of it."

"Now there's something," put in Hansen. "Aren't they doing anything about it?"

"What can they do? They swear that all the evidence satisfies them that neither man's condition could be brought on by artificial means. Neither had eaten, drunk or been injected with anything that might cause it. So far as can be ascertained, both deaths were entirely

natural in spite of the fact that the last took place in highly suspicious circumstances. So that is that!"

They were silent a long time, brooding while their thoughts worked at top pressure, then Hansen remarked: "Come to think of it, all these guys about whom you want reports have one thing in common."

Armstrong sat up, drawing in his legs. "What's that?" he inquired, sharply.

Hansen said, "They're all alive."

Shoving out his legs again, Armstrong relaxed. "Of course they are. Fat lot of use getting data on dead men."

"Why not? Some of them might have shared this elusive common denominator of yours when living."

"True enough."

"In addition to which, some of them may have died naturally."

"Meaning what?"

"Some of them may have curled up with cardiac thrombosis."

"Boy, they might, indeed!" He tossed the idea to and fro. "Supposing we tracked down a dozen who died that way—what of it? Any medic will tell us that a dozen kick the bucket the same way, every day, in New York alone. Mind you, I'd still think it means something. But what does it mean?"

"You've a notion of what it means," suggested Hansen shrewdly. "You pulled a fast one on Sandy-hair with that camera of yours, but the camera itself showed that Sandy-hair pulled a fast one, too. You're not half-blind and dopey. Dollars to doughnuts, you saw what I saw and have thought about it fifty times since." He twiddled the ring again. "And since officialdom has confiscated the film, it's a dead cert that the cops are ruminating the same notion, or soon will be."

"Yes," Armstrong admitted slowly. "That thing Sandy-hair was holding as he stood by the door. It looked like a torch, but who'd face the light behind an opening door with a torch ready in his hand? It's illogical. Nevertheless, he went for it just as if he were going for a gun—and it wasn't a gun." He stared at the other. "That fellow's very stance and expression told that the object was a weapon of some sort. My guess is that it was a gas projector."

Hansen nodded. "That was my conclusion. When he came face to face with Marshall, he gave him a squirt that laid him out." He licked thin lips. "I can theorize about that weapon only in terms of the known, although the known isn't always the familiar. I don't accept that it could be any absolutely novel gadget. I concluded that it was a pocket gas projector. So yesterday afternoon I rang up Dr. Lowry, and asked if he knew of any gas that could cause cardiac thrombosis."

"And what did he say?"

"He said the idea is absurd."

"There we go again—nowhere," Armstrong grumbled.

"He poured out a flood of ten-dollar words that all meant the same thing—no gas could cause it." Licking his lips again, he added, "But—"

"Go on! You're not tongue-tied!"

"But a gaseous irritant powerful enough to bring on respiratory convulsions might cause death to a person already in a certain condition of thrombosis." He carried on to explain it more ghoulishly. "The victim would heave his pulse sky-high and pump the clot into his heart."

"That tells us a heck of a lot," declared Armstrong, down in the dumps again. "I saw Mandle slide out. I saw him with my own two eyes. He didn't even cough."

"I know. I checked up on Mandle myself. I checked on Marshall's autopsy, too. He wasn't gassed, or not with anything that left a trace in his lungs. Neither had he had convulsions—that's definite."

"So we're back at the start. Sandy's gas-projector didn't project gas." His bushy brows drew together. "Here we go round the mulberry bush."

"You owe me a century," Hansen reminded. "That's the way the money goes—pop goes the weazle."

Armstrong stood up, paid it over. "Momentarily, it's an impasse. I'll bust out of it somehow, even if I have to stick out my neck until someone can't resist taking a chop at it. However, I may be able to strike a new line when I've got all of your reports. A few aren't enough for my purpose. I need the lot—and the sooner, the better."

"Leave it to me," said Hansen, easily. "I'll get the job finished as soon as possible. I'm combining it with a line of my own."

His hand holding the door half-open, Armstrong paused on his way out. "Mind telling me?"

"The search-line. Those guys didn't go through your apartment and your laboratory just for the ducks of it. They were looking for something even though we don't know what. Now if any others on these lists of yours have been searched or slugged, it might give me a pointer. I'm digging data on that angle."

"You're wasting your time." Armstrong watched interestedly as Hansen opened his mouth, then closed it without saying anything. He continued: "I've played that angle until I'm pretty sick of it. It always gets me the same place, namely, that the Feds know the object of the search, but won't tell. Those guys were looking for something I haven't got and am not supposed to possess. Either they wanted to discover what it is, or else they wanted to make sure I haven't got it."

"And the Feds refuse to blat?"

"Yes."

"Then it's Old Whiskers' biz." Hansen rubbed his forehead wearily. "Hell's bells! We sink deeper and deeper every minute without knowing what we're sinking into."

Hunching his broad shoulders in phlegmatic resignation, Armstrong closed the door, went to his apartment.

Hansen or someone had tidied up the place before locking it, a fact for which he was duly grateful. Shucking his overcoat, he slung it

onto a hook, dug out the spy camera, reloaded it, set it for action, fitted it back into its hiding place.

Then he phoned Claire Mandle. She bloomed into his screen as neat and as pert as ever.

"Oh, it's you, Mr. Armstrong!"

"John!" he insisted.

"Tut!" she came back. 'We haven't been introduced."

"That's why I insist on John. It's rather too early for anything more endearing."

"From which I gather that you're not calling me in any official capacity, but because of the flowers that bloom in the spring, tra-la. Once again you have an ulterior motive." Her sigh was annoyingly melodramatic. "Very well, you may pursue the matter—John!"

"Look," he ordered, "I called to see whether we could meet again some place."

"Undoubtedly we could. I don't know that we should."

"I wanted to ask you an important question."

"Gracious! So soon?" She gazed at him in mock surprise.

He went on, his voice rising: "If you won't give me the opportunity to discuss it in person, I'll have to ask you now."

Her response was to lower her eyes modestly, an able performance which he observed with gradually reddening face.

Taking a hold on his emotions, he gritted: "Has anyone cased your place and gone through your papers of late?"

Startled, she looked up. "How on earth did you know?"

"So someone has!" he observed grimly. He made full use of the heaven-sent opportunity to get tough with her. "If you want the whys and wherefores, it's got to be over a cuppacawfee and not over this phone."

"That's your ultimatum?"

"It is."

"Bully!" she defined. "All right, I'll give in. I'll come quietly. Tonight?"

"Wow!" he enthused, thinking it childish and not caring.

Her smile was genuine. "Same place, same time?"

"Or sooner!"

He watched her fade out of the screen, then kicked a cushion across the room, bounced it a few times on his head. Then he smacked his hands together, said, "Wow!" a couple of times, and sobered down sufficiently to have a shave.

Dead on time again, she turned up in a slick, tailored costume and a little deerstalker which was recognizably a hat.

"Well," she began, when they were seated, "are you going to let me in on the mystery?"

He sat facing her, arms akimbo on the table, and gazed at her intently, without answering. The gaze went on a long time and, after a while, her tilted eyes widened slightly, she produced a compact, opened it, inspected herself in its mirror. She failed to find the suspected smut on her nose. Replacing the compact, she leaned forward, gave him a smart rap on the knuckles.

"Animate yourself! I asked you a question!"

Shaking his head slowly and profoundly, he said: "Fancy, all that and brains as well!"

"What's the matter?"

"Nothing's the matter. That's the point. Why should you alone be perfect?"

"You need glasses," she scoffed. "Besides, would you rather have me dopey?"

"Heaven forbid!" he prayed fervently. "But even if you didn't know the day of the week, I would still—"

She rapped his knuckles again, harder this time. "This is the Longchamps, not the Zoo! Pull yourself together and tell me about these prowlers."

Opening his mouth, he intended to retort, "You started it," but changed his mind and said: "Oh, yes. My place got a rake-over three or four days back. So did my lab in Hartford. What they were looking for is a mystery which has got me bothered." He eyed her carefully. This was delicate. He'd have to be careful not to ham the job. "Since this occurred soon after our last talk, I wondered whether there was any connection. That is to say, maybe we were suspected of sharing information of some sort—in which case you should have been victimized, too."

"I see." She was frankly mystified. "What on earth could we share which would justify a search?"

"We might have shared whatever they sought at your place," he riposted.

It didn't faze her. On the contrary, she was more puzzled than ever. "Somebody sneaked in yesterday, went through all my documents, left my desk and my library in a mess, but took nothing."

"You're sure that no item is missing?"

"I'm positive."

"None of Bob's papers, for instance?"

"None of those, either." Her glance was quizzical. "What has Bob got to do with it, anyway?"

"All I know is that he was concerned in a government job which is a top secret."

"Who told you that?"

"The F.B.I."

There was no way of telling whether this information hit home. She had excellent self-control, and took it coolly. Her manner was deliberately reflective as she thought it over.

"Bob was involved in something concerning space-rockets, I do know that. Just what he was up to is not apparent from any papers he left behind, except that he'd developed his Layer Theory. Evidently he kept nothing which concerned work for the government; presumably he passed his stuff straight to the government and destroyed the rest. Bob always was very methodical and extremely cautious."

"As he should be if mixed in a top secret job," Armstrong approved.

"Since rocket number eighteen is under construction at the present

moment," she went on, "it looks very much as if Bob were busy with something concerning it. Possibly number eighteen will be an extra-special construction incorporating a revolutionary idea which the authorities are keeping to themselves."

"Number eighteen is practically a dead duck," he contradicted. He told her all he knew of the rocket, detailing his recent visit to New Mexico, his sparring match with Fothergill, and what he'd since learned from Quinn. "I don't know what you think," he concluded, "but to me those holdups look somewhat deliberate, as if the rocket is being delayed as much as possible without making the fact too obvious."

This information gave her subject for thought which occupied her mind quite a while. Her elfin eyes were serious with concentration as she examined the evidence.

At length, she said: "This poses a curious paradox. The ship is government-sponsored and yet some, though not all of the snags look government-inspired. The government is trying to build the ship and, at the same time, to delay its completion. Maybe someone else wants to delay it also, and that complicates the situation, but let's ignore that factor and concentrate on the governmental aspect. Why should the powers-that-be try to build the vessel, but not too soon?"



"It isn't lack of money for one thing. Ask me an easier one!"

"We've got to ask it. There's logic somewhere in this seeming illogicality."

"The only other solution I can think up isn't as plausible as it ought to be."

"What is it?"

"Maybe this top secret—whatever it is—needs further development before it can be applied to the ship. So the vessel's construction is being held back in case of necessary alterations. But why start it one way and change it to another when, just as easily, they could have timed its commencement to fit in with new plans embodying new notions? I know that bureaucrats do nutty things, but not as nutty as that!"

Her small nose wrinkled in disapproval. "For my part, I don't think you've got it."

"Neither do I. You concoct me a better one."

She mulled it over again. He ordered drinks, and she was still occupied with the problem when her glass was empty. He spent the time

studying her face. He was still gaping at her when suddenly her eyes brightened.

"Supposing that eighteen isn't a dead duck at all."

"O.K., suppose it isn't—then what is it?"

"A decoy duck."

"What!" he yelped.

"Shsssh!" She glanced around at the nearest tables. "Don't bellow like that!" Her voice became low, confidential. "Half the world has pondered the idea of systematic rocket-sabotage in its usual lackadaisical, apathetic way. The authorities are certain to have given the theory a lot of consideration. Now let's suppose they're ready to put a super-rocket on the stocks but are leery about all the queer things that have happened to its predecessors." Her look was sharp, penetrating. "What would *you* do?"

He smacked the table with a huge hand. "By gosh! I'd build it quietly and surreptitiously some place like the North Pole. And I'd build another, well-publicized one in New Mexico, for the saboteurs to play with."

"Brainy boy!" she admired.

Ignoring that remark, he went on, "One item has got me worried."

"You may open your soul to me."

"It's the way you gnaw at problems. Some day, some guy will have to think up some awful good excuses—or else!"

"That'll be his worry, won't it?" she pointed out.

"Sure! I told you I'm worrying already!"

For the first time, she pinked a little, a phenomenon he observed with lordly satisfaction. She was conscious of it, for she dug out the compact, dabbed at her face with a piece of lace This, too, he studied with the same expression.

When she had finished, she said, tartly: "You can't concentrate on two problems at once and get somewhere with both."

"That remains to be seen," he contradicted. He waved a waiter, and when fresh glasses had been brought, leaned forward confidentially. "Let's drop the cross-talk while I consult you about the state of my liver."

"Good gracious!" she murmured, taking a slow sip from her glass.

"These days I get the wackiest feelings," he went on doggedly. "I can't help wondering whether other folk get them too, or whether it's that I'm abnormal in some way."

"What sort of feelings?"

"A peculiar mixture of apprehension, irritation, suspicion and general nerviness."

"And when do you get them?"

"Most anytime. I read the press-recorders and the feelings promptly come on. I look at the sky-signs and they come on. I listen to the radio and they crowd in upon me. One moment I can be on top of the world—then the most insignificant thing suddenly hems me in. I'm getting more temperamental than a prima donna."

"You need a good dose of Vitalax," she diagnosed.

His scowl was heavy, ferocious. "That's precisely the sort of remark

that does it! Every day and in every way I'm reacting more and more!"

Putting her glass down, she looked serious. "If I may say so, John, you should have a long rest."

"I don't think so. I was joking about my liver. Physically, I'm topnotch. The trouble is a mental one. It's got a cause." He regarded her levelly. "I don't know the cause but something keeps telling me it's an important piece of the puzzle I'm trying to put together."

"Do you really suggest that your irritability is connected with these rocket problems?"

"Claire, for the life of me I can't imagine how the one can possibly be connected with the other—nevertheless I am as certain of that link as ever I've been certain of anything."

"Have you tried to identify any causes and analyze them?"

"Yes, sure—but it doesn't work out. It only leaves me wondering what the heck's the matter with me." He glanced around moodily, and his eyes were slightly baffled when they returned to her. "For example, while watching the crowd the other evening I noticed a dark-skinned, smooth-looking guy wearing a green turban. Obviously a swami; Shri Bannerji, or some name like that. Immediately my mind leaped to Hindu ascetics. I thought of those who stare fixedly at the sun for years and years until they go completely blind—then continue sightlessly staring for the remainder of their miserable lives. I thought of others who hold up one arm until it withers, and others who squat cross-legged until their nether limbs become shrunken and deformed and they have to be carried around. The feeling came on me. It came on in overwhelming strength. I felt jumpier than a cricket on a hot stove."

There was a queer light in her eyes as he came to the end of this recital. "How do you feel when with me? Seriously now—no wisecracks."

"Soothed," he told her. "Soothed and calm and placid."

Her laughter tinkled gently. "As if I were not of this world?"

"You're not quite an angel, thank goodness," he evaded. "You're a woman. I prefer you that way."

"That doesn't answer my question."

"I'll answer it," he said, surprisingly, "when I've managed to get hold of the facts."

Their eyes remained level, looking straight into each other's, while her phrase drummed in his mind as regularly, as rhythmically as a pulse. Not of this world . . . not of this world . . . not of this world. There was an idea, now! People not of this world!

She was the first to lower her gaze.

VI.

It was noon of the fourth day after Hansen's last report had arrived when Armstrong shoved aside the mass of papers littering his table, rubbed his heavily bearded jowls and reached for the phone.

"Is Hanny there?"

Miriam drawled: "I'll put you through to him, Client."

The dour face of Hansen grew into the screen. The agent said: "Did you get the bill?"

"Yes. The check's in the mail."

"O.K.! Anything more?"

"More? Ye gods, we've hardly started yet! I fancy I've found something in these reports. You'd better come round."

"Give me twenty minutes." Hansen faded out.

A quick shave refreshed Armstrong but failed to remove the lines of tiredness around his red-rimmed optics. He washed his eyes with an eye-bath, was blinking them when Hansen arrived. Towel in hand, he admitted the caller.

Grabbing a chair, Hansen slumped into it. "Well, Sherlock?"

"Out of one hundred seventeen reports I've found thirty-four suspects sharing one feature in common. What they share is membership in the Norman Club."

"Humph!" Hansen was not at all impressed.

"Ever heard of it?"

"Never." The agent waved a hand airily. "There are as many clubs in the world as fish in the sea. Most of them are no more than petty ego-inflatories. What's peculiar about the Norman Club?"

"Several things. For a start, it's international, although few people seem to know of it. There's a Norman Club in every country in the world and in practically every city of any size. It is extremely exclusive. Only its members know what it's about and the reason for its existence."

"Where did you dig up that dirt?"

"From the Central Registry. All clubs and organizations have to be registered, as you know. This one is said to be literary and strictly nonpolitical. It's the bunk—there's something more behind it."

"Ho-hum," said Hansen. "So you want me to investigate this crowd?"

"No, I don't. I'm going to barge right into their local dump and get it myself, if possible." Giving his eyes a final rub, he tossed the towel onto its rack, sat down facing his listener. "I believe there's something to be got. Sandy-hair took his own escort around with him and I think it's a good notion."

"Run it your own way," said Hansen imperturbably. "So long as I get cash on the barrelhead."

"I want you hanging around back of me in case I get some place too tight." Leaning to one side, he stretched, opened a cupboard, took out a small, dull-black instrument with a tiny, cone-shaped mesh of fine wire swiveling on its top. Giving the thing to Hansen, he added a long, careful list of instructions and ended, "Make it six o'clock this evening, corner of Sixth and West Fifty-eighth. Once you've picked me up you're on your own—use your own judgment."

Hansen stood up, toyed doubtfully with the instrument, thrust it into his right-hand pocket. "So be it. I'll be there. But if you peg out with a blood clot I'll be some place else—mighty fast! The

Norman Club—pah!" He went to the door. "Probably a gang of punks who collect French literature—I hope!"

Grinning at him, Armstrong said nothing, watched him go out. He hadn't overlooked Hansen's half-jocular guess. The name of "Norman" suggested French origin or some sort of Frenchy connection. And there was a branch in Paris. But there were branches in other places where French literature would smack of coals to Newcastle. One city's poison was another city's meat. The Norman part of it, he concluded, had some significance quite different from the obvious. It wasn't necessarily French, or even European, or even—what?

Darn it, his brains were starting their antics again. Away his mind wandered, all on its ownsome, from proposition to proposition, each one successively wilder, and threatening to hand him some conclusion so elusive that he could get it in his grasp but not within his grip. It was the maddening dance of that conclusion which gave him the meemies; he knew that, knew it instinctively without being able to identify the cause.

Barely outside the realms of consciousness, just beyond the border of comprehension lurked a shadowy theory which mocked his mind and jeered at him repeatedly.

"Come on, pal—come and get me! I spy, with my little eye! Yoo-hoo, big boy—you can't see me! Hidey, hidey, where do I bidey?—nobody knows but Old Mother Tidey!"

It was a ghostly idea. Or a ghastly one. Or even a fact, a tremendous, world-shattering fact which deftly skipped out of his reach every time he made a snatch at it. It gibbered at him in the sky-signs; it hooted at him through the radio; it blared and blatted among the mobs in the streets; it gibbered derisively in the pompous speeches of leading figures; it whispered sibilantly through the lips of stone-blind ascetics, and it cackled amid a multitude of prayers.

"Some jeer at me for leaning all awry—what, did the hand then of the Potter shake?"

He was perspiring again. Heavy-footed and cumbersome, like a caged bear, he prowled up and down the carpet, up and down, up and down. The floorboards squeaked beneath his weighty tread. Up and down. What time does the Zoo open? Have they let the visitors in? Have they brought any buns? Who is the Potter, pray, and who the Pot? She will love Chiclemint. Chew-chew, baby. Violently, he kept punching his right fist into the palm of his left hand. Six o'clock—roll on six o'clock!

The Norman Club suggested a million dollars without being obtrusive about it. It had a huge, arched doorway set in an imposing graystone front which soared ten floors up. Within the doorway was a plate glass revolving door, and beside the door posed a commissionaire attired like a ten-star general in the Ruritanian army.

Mounting the wide marble steps

leading to the door, Armstrong reached the top, at which point the general extended a white-gloved, gentlemanly hand and spoke in well-modulated, gentlemanly tones.

"I beg your pardon, sir."

"It is granted," said Armstrong with unhesitating generosity.

"Admission, sir, is permitted to members only."

"Oh." Armstrong tilted his hat forward, scratched the top of his neck. The general observed this indelicate operation with well-bred forbearance which told that membership of the club positively did not include people who scratched. Armstrong eyed him calculatingly. "How does one become a member?"

"One must be recommended, sir."

"By whom?"

"By a present member, sir."

"Ah, yes, of course." He gave the door a tentative jerk which started it spinning slowly. "It seems that I'll have to go inside and persuade my most influential friend to recommend me."

The general permitted himself a martial frown, took a step forward, put out a restraining arm. "I regret, sir—"

Carefully Armstrong put a big foot on the other's glossy boot and gave him an equally careful push in the chest. The general sat down suddenly and hard. With a swift glance up and down the street, Armstrong went through the revolving door, found himself in a thick-carpeted foyer.

Here, a distinguished individual with mirror-polished hair met him, took his hat and coat, gestured gracefully to the door at the farther end, and said: "That way, sir."

"Thank you." Wading through the carpet's high pile, he reached the door, looked back, noted that outside in the street the uniformed squatter had regained his feet and resumed his original pose. He was not attempting to come in, evidently being unsure of himself, or perhaps content to let those inside cope with the brusque invader. Smiling his satisfaction, Armstrong opened the door, entered the room beyond.

Softly the door closed itself behind him, emitted the faintest of clicks. The room's sole occupant—a man seated behind a distant desk—looked up. He was a swarthy, highly groomed individual with very black eyes.

Expressionlessly regarding his visitor, he spoke in cultured tones. "Glad to see you, Mr. Armstrong." His manicured hand indicated a chair. "Please take a seat." Then he pressed a stud on his desk.

Sitting cautiously, Armstrong rumbled: "So you know me?"

"Of course, of course." The other's laugh was short and artificial. "We have been expecting you. Our Mr. Rothman will be here to see you any moment. He won't be long, I assure you."

"All right." Armstrong crossed thick, powerful legs, glowered at the swarthy man who, quite unconcerned, began busily to attend to the papers on his desk.

We have been expecting you—how in the name of all that's holy could they possibly expect him?

Nobody knew that he was coming excepting Hansen and, perhaps, Miriam. Unlocking his legs, he stood up, went to the door by which he had entered. He tried it. As expected, it was locked. He returned to his seat. The swarthy man hadn't bothered to look up, and continued nonchalantly to deal with his papers.

"Where's our Mr. Hansen?" Armstrong asked him.

The other glanced at him, black eyes quizzical. "Mr. Hansen?" He pondered a second or two. "Oh, yes, Mr. Hansen. We shall attend to him in due time, and if necessary." His eyes shifted to the second door at one side of his desk. "Here is Mr. Rothman."

Armstrong was on his feet, one hand in his pocket, as Rothman entered. The newcomer proved to be a big, heavily built man tending to fatness. He had a florid face surmounted by a mop of curly white hair. Nodding affably at the swarthy man, Rothman advanced eagerly toward Armstrong with extended hand.

"My dear Mr. Armstrong! Delighted to meet you!" His grasp was firm and strong, his shake the essence of cordiality. Chuckling his pleasure, he slapped Armstrong on the back. "D'you know, I had a small wager that you would be here before another ten days had passed."

"Really?" said Armstrong glumly. This reception was the nuttiest item in the entire nutty set-up. It had him puzzled. "Who told you —Hansen?"

"My goodness, Mr. Armstrong, you wouldn't expect *that* of us, would you? We have sources of information *so* much more reliable." Chuckling again, and talking with friendly enthusiasm, he conducted Armstrong to the second door. At his desk, the swarthy man got on with his work and ignored them. Rothman went on: "I don't doubt that you'll find our outfit very different from what you may have anticipated—but so does most everyone who gravitates to us. We are quite a sober crowd, yes, quite a sober crowd." Reaching the door, he opened it wide.

Armstrong, bang in the middle of the doorway, caught only the briefest possible glimpse of a group of half a dozen men around some unfamiliar piece of apparatus faintly resembling a gigantic movie camera. It gave him no time to ponder the scene, to do anything about it; not even to swing the clenched fist he had ready; not even to spring aside or flop to the floor.

The picture of the gadget and its waiting team registered in his eyes a split second before the machine emitted a tremendous blue flash, upon which his senses shot skyward and his big body collapsed. He lay as relaxed as a bundle of rags while a smell of ozone pervaded the room. Behind him, the swarthy man calmly shuffled his papers and continued with his writing.

He came to in a sumptuously furnished cell, dry-mouthed but unharmed. There was a bed, an inlaid table, a small bureau, a couple of deep, springy armchairs, a large

electric radiator, a rack of expensively bound books and many other items not normally found in cells. Surveying them blearily, he ran a tongue like tinder around his parched palate, went to the corner washbasin, worked the cold faucet for most of a minute.

There was no door to the cell, its place being taken by a heavy grille of inch diameter beryllium-steel rods. Going to the grille, he shoved his head between its bars, had a look along the passage outside. The facing wall was blank, but there was a cell on each side of the one he was occupying and presumably there were more still farther along.

Shaking the grille, he called: "Anyone at home?"

Somebody moved in the cell immediately at his right. Its occupant came to his own grille, but neither were able to see the other. Armstrong's invisible neighbor spoke, his voice that of a much older man.

"So you've recovered your senses, eh? I wondered how long it would take you to snap out of it. I've called you about ten times these last couple of hours. How did they get you?"

"I'm not sure. Something burst into a big blue light and I went out like I'd been slugged. Where are we?"

"That's what I wanted to ask you." The other was silent a moment, then said: "Anyway, now you're up and awake you can answer another question for me—an important one."

"Go ahead," invited Armstrong, straining futilely to peer farther through the bars.

"What is life?"

"Eh?"

"What is life?" repeated the other.

"Who cares?"

"I do. I care a lot. I've got to answer this one question at all costs. Upon my answer depends my neck. It may get broken. Or something worse, if there's anything worse. I don't know. But I've got to answer one question, and that is, 'What is life?' "

Taking a fresh grip on the grille, his knuckles whitening, Armstrong said between his teeth, "Who's put that question? Who wants the answer? Who's threatening to break your neck, and why?"

"If I tell you all those things," retorted the unseen man in the next cell, "you'll start thinking about them and won't seek the answer to my question. You find me an answer, a good one, and then I'll tell you what little I know." He stopped, emitted several deep, racking coughs, then continued: "You might as well sharpen your wits while you still possess them. It'll be your turn next. One question! —and for your sake I hope you find the answer!"

"What's this—a quiz game?"

"That's what they've made it. The losers get buried!"

"You're nuts!" defined Armstrong, positively.

Leaving the grille, he reclined in a chair, stared with jaundiced eye at the wall. Had he been smuggled into an asylum? By all accounts

they were places easy to enter and almost impossible to leave. If so, who had put him in, and on whose authority? Was this the supremely smooth and crafty method by which pernicious influences got unwelcome snoopers out of the way? Or were his own many recent obsessions proof that he was not—normal?

Maybe that monstrous blue flash had been only a dream, a delusion. Maybe he'd flopped right into the surprised arms of an innocent and pally Rothman, the victim of an overdue nervous breakdown or something as bad. A tumor on the brain, perhaps. No, it couldn't be that—his brain could whirl and do side-slips, but it could still think, and he felt mentally fit despite all his past cerebral surgings.

His ruminating gaze shifted to the row of books, but his eyes did not see them, and his ears heard only faintly and inattentively the low, constant mumbling of the prisoner in the next cell. If they wanted to bump him they'd have done it before now—unless they wanted to get something out of him before slapping him down for ever. Perhaps they were after the mysterious information for which Sandy-hair had searched in vain. It wasn't likely that they needed only a satisfactory answer to one question. To make a victim purchase his life with a single pearl of wisdom was the height of imbecility. This quiz-palaver was the sheerest hooey!

"What is life?"

Despite his mental rationalizing, the question insisted on popping up repeatedly within his mind. It nagged at him until he got out of his chair, paced his cell several times, and eventually found himself back at the grille.

"Hey!" he called to his unseen neighbor. "What do *you* think life is?"

The other ceased muttering, came close to his bars. "When I was a kid I was taught that life is a stepping-stone to higher things. That's the answer I ought to give. But supposing it's not the one which satisfies them? Supposing they get that answer, and take me out and . . . and—"

"Well?" Armstrong prompted.

"I don't know. I'm not sure the answer's right—and its *got* to be right! You'll know how right it's got to be when they ask you yours!"

Ignoring that sinister comment, he demanded: "How many other likely definitions have you thought up?"

The other hesitated, said doubtfully, "Life is growth."

"Crystals grow," Armstrong pointed out.

"That one's wrong then. How about life being motion?"

"Trees don't move of their own volition."

"They grow, though. And growth's a form of motion."

"Planets move. So do satellites, asteroids and various other whatnots which aren't exactly alive."

"Oh, for heaven's sake, if you can quibble they can quibble, too. I've thought of dozens and they've all got snags." His weary voice betrayed nervous strain. "One snag

is enough." He was quiet for a while, then came back with, "If you had been asked it, what would you have said?"

Armstrong gave it considerable thought before he replied, slowly: "I'd say that life is a predicament of matter—and stand pat on that."

Unenthusiastically, the other murmured: "Thanks! I'll think it over." Volunteering no further information, he went away from his grille and began muttering again.

He didn't have long to think it over. Within ten minutes a pair of burly, hard-faced men appeared in the passage, paraded past Armstrong's cell without so much as a glance inside, unlocked the grille next door. Armstrong stood behind his own grille to watch them return.

A moment later they came past, a stoop-shouldered, wizened man between them. Peering myopically over low-slung pince-nez, the prisoner stumbled as he walked along. The guards on either side of him were as impassive as a pair of sphinxes.

Armstrong said pleasantly to the nearest guard, "About two hundred pounds—you'll need eight feet of rope."

They might have been deaf mutes for all the effect it had. They went grimly on, the prisoner mumbling querulously between them. At the end of the passage the sound of their steps and the captive's voice cut off abruptly with a noise like that of a slammed door. All was silence. Evidently there was nobody in any of the other cells. Armstrong was alone with his thoughts.

He spent the following hour searching his cell for midget microphones, button-scanners or any other snooping oddments which might be installed. No soap. Upending the furniture, taking down all the books, seeking in every spot of which he could think, he had a busy time which kept him amused but brought no reward. If they'd planted anything of a spying nature, it was buried in the plaster. He'd have to tear down the walls and ceiling to find it.

Satisfied that there was nothing which he could uproot, he washed, brushed his teeth, tidied himself, glanced over the books. Momentarily, none of them interested him.

One of the guards came along shortly, pushed a supper tray under his grille, went away without a word. Breakfast arrived in the same manner the following morning. The food would have done credit to the snootiest hotel. It seemed that whatever fate they had in store for him included fattening up before the kill. Eating the lot with open relish, he decided that the menu provided his only cause for gratitude.

By dinner time his appetite was spoiled by mordant thoughts about his still-absent neighbor. The old fellow—whoever he was—had not reappeared. Maybe he'd given the wrong answer and had suffered all that he'd anticipated. Maybe this lunatic stunt of making one's fate depend upon a single question was

somebody's sardonic way of dealing with those who had asked too many questions. An eye for an eye.

But the Norman Club definitely was part of the mysterious picture, a cogent part, a key piece. Knowing it wasn't doing him much good, but Hansen also should know it by now—unless the dour agent was one of the best actors and the most accomplished liar Armstrong had ever encountered. Though his mind long had been obsessed by suspicions, he was not inclined to suspect Hansen. The arrangement between them had slipped up somewhere. It was due to his own foolhardiness. Fools rush in, and all that.

Lugubriously he felt in his vest pocket for the twentieth time. The something which should have been there was missing. They'd beaten him to the draw there! If only he'd been able to retain it, half the cops in New York would be busting into this dump by now. The fact that they weren't was proof that the item was no longer functioning—they had known how to deal with it.

A few moments later all speculations were put away. His dinner was shoved under the grille and went cold before him. There was a clean white envelope propped against the carefully laid plate of fried chicken. Picking it off the tray, he tore it open, read its neat typescript aloud:

"Dear Mr. Armstrong: What may happen to you ultimately will be decided by the manner in which you find an answer to the simple question inscribed below. Of course, you will give it serious thought since your fate is a serious matter. Take your time about it—you will have at least two days in which to give it your most earnest consideration."

There was no signature. He looked at the six words printed in large block letters at the bottom of the note. His brain sideslipped, swung around in mad abandon so that his thoughts became a chaotic swirl. Dampness crept over his back. A multitudinous host of all the eerie feelings he'd ever experienced swept upon his revolted mind with the frightening impetuosity of a ghostly cavalry charge. A full quarter of the mystery-picture blazed before his grim, unseeing eyes, brilliant, in infernal colors. A vision of hell itself.

This was the pay-off! Gradually, draggingly, almost hypnotically, his eyes wandered back to those six fateful words.

"How do you know you're sane?"

TO BE CONTINUED.

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IN TIMES TO COME

Next issue will, of course, carry on "Dreadful Sanctuary," bringing in the peculiar and peculiarly hard-to-grapple premise of the Norman Club. But, in addition, we have another long novelette by H. Beam Piper, "Police Operation." There are those who seem to feel that his recent "He Walked Around The Horses" was a fantasy; Piper insists—and with "Police Operation" demonstrates—that such is not necessarily the case. In fact, "Police Operation" brings into operation a beautiful hypothesis to answer the Fortean proposition to explain all the odd things newspapers report—and I find Piper's explanation more fun!

You'll want the cover of the next Astounding Science Fiction, too; it's another one of Bonestell's magnificent astronomical paintings. This one shows a first spaceship landing on the surface of the Moon, with a detail and reality no artist other than Bonestell could achieve. We don't ordinarily go in for biographical material on our authors and artists, but Bonestell's unusual fitness for the work he's doing in science-fiction paintings is worth discussing. Originally trained as an architect, he became interested in the art side of architectural drafting, switched to art entirely, and developed in that field. But the architectural training—draw correctly the shadow cast by a dormer window facing north-northeast at 1:30 p.m. on July 18th in the New York City area, assuming the main roof angle is 37°—has made him a past master of calculating all the angles. His science-fiction paintings are largely a hobby; his main work is painting scene backgrounds for Warner Brothers studios, a job that requires accuracy sufficient to fool the sharp eye of the camera. His pictures are painted generally on the basis of a 40° angle of vision—about normal for ordinary human visual comprehension. As you know, he works considerably with R. S. Richardson, and other Mt. Wilson men, in pinning down the details of his astronomical scenes.

THE EDITOR.



NO CONNECTION

BY ISAAC ASIMOV

Kipling's Fuzzy-Wuzzy was no bear—but perhaps if he had been a better answer than violence and death would have been found—if Kipling had been a bear too.

Illustrated by Cartier

Raph was a typical American of his times. Remarkably ugly, too, by American standards of our times. The bony structure of his jaws was tremendous and the musculature suited it. His nose was arched and wide and his black eyes were small and forced wide apart by the span of said nose. His neck was thick, his body broad, his fingers spatulate, with strongly curved nails.

If he had stood erect, on thick legs with large, well-padded feet, he would have topped two and a half yards. Standing or sitting his mass neared a quarter of a ton.

Yet his forehead rose in an unrestricted arc and his cranial capacity did not stint. His enormous hand dealt delicately with a pen, and his mind droned comfortably on as he bent over his desk.

In fact, his wife, and most of his fellow-Americans found him a fine-looking fellow.

Which shows the alchemy of a long displacement along the time-axis.

Raph, Junior, was a smaller edition of our typical American. He was adolescent and had not yet lost the hairy covering of childhood. It spread in a dark, close-curled mat across his chest and back, but it was already thinning and perhaps within the year he would first don the adult shirt that would cover the proudly-naked skin of manhood.

But, meanwhile, he sat in breeches alone, and scratched idly at a favorite spot just above the diaphragm. He felt curious and just a little bored. It wasn't bad to come with his father to the museum when people were there. Today was a Closed-Day however, and the empty corridors rang lonesomely when he walked along them.

Besides, he knew everything in it —mostly bones and stones.

Junior said: "What's that thing?"

"What thing?" Raph lifted his head and looked over his shoulder. Then he looked pleased. "Oh, that's something quite new. That's a reconstruction of Primate Primeval. It was sent to me from the North River Grouping. Isn't it a nice job, though?" And he returned to his work, in the grip of a momentary twinge of pleasure. Primate Primeval wasn't to go on exhibition for a week at least—not until he prepared an honorable place for it with suitable surroundings, but for the moment, it was in his office and his own private darling.

Raph looked at the "nice job" with quite other emotions, however. What he saw was a spindly figure of contemptuous size, with thin legs and arms, hair-covered and owning an ugly, small-featured face with large, protruding eyes.

He said: "Well, what *is* it, Pa?"

Raph stirred impatiently: "It's a creature that lived many millions of years ago, we think. That's the way we think it looks."

"Why?" insisted the youngster.

Raph gave up. Apparently, he would have to root out the subject and do away with it.

"Well, for one thing we can tell about the muscles from the shape of the bones, and the positions where the tendons would fit and where some of the nerves would go. From the teeth we can tell the type of digestive system the animal would have, and from the foot-bones, what type of posture it would have. For the rest, we go by the principle of Analogy, that is, by the outside appearance of creatures that exist today that have the same kind of skeleton. For instance, that's why he's covered with red hair. Most of the Primates today—they're little insignificant creatures, practically extinct—are red-haired, have bare callosities on the rump—"

Junior scurried behind the figure and satisfied himself on that score.

"—have long, fleshy probosces, and short, shriveled ears. Their diets are unspecialized, hence the rather all-purpose teeth, and they are nocturnal, hence the large eyes.

It's all simple, really. Now, does that dispose of you, youngster."

And then Junior, having thought and thought about it, came out with a disparaging: "He looks just like an Eekah to me, though. Just like an ugly, old Eekah."

Raph stared at him. Apparently he had missed a point: "An Eekah?" he said, "What's an Eekah? Is that an imaginary creature you've been reading about?"

"Imaginary! Say, Pa, don't you *ever* stop at the Recorder's?"

This was an embarrassing question to answer, for "Pa" never did, or at least, never since his maturity. As a child, the Recorder, as custodian of the world's spoken, written, and recorded fiction, had, of course, had an unfailing fascination. But he had grown up—

He said, tolerantly: "Are there new stories about Eekahs? I remember none when I was young."

"You don't get it, Pa." One would almost suppose that the young Raph was on the very verge of an exasperation he was too cautious to express. He explained in wounded fashion: "The Eekahs are real things. They come from the Other World. Haven't you heard about *that?* We've been hearing about it in school, even, and in the Group Magazine. They stand upside down in their country, only they don't know it, and they look just like Ol' Primeval there."

Raph collected his astonished wits. He felt the incongruity of cross-examining his half-grown child for archaeological data and he hesitated a moment. After all, he had heard *some* things. There *had* been word of vast continents existing on the other hemisphere of Earth. It seemed to him that there were reports of life on them. It was all hazy—perhaps it wasn't always wise to stick so closely to the field of one's own interest.

He asked Junior: "Are there Eekahs here among the Groupings?"

Junior nodded rapidly: "The Recorder says they can think as good as us. They got machines that go through the air. That's how they got here."

"Junior!" said Raph severely.

"I ain't lying," Junior cried with aggrieved virtue. "You ask the Recorder and see what *he* says."

Raph slowly gathered his papers together. It was Closed-Day, but he could find the Recorder at his home, no doubt.

The Recorder was an elderly member of the Red River Gurrow Grouping and few alive could remember a time when he was not. He had succeeded to the post by general consent and filled it well, for he was Recorder for the same reason that Raph was curator of the museum. He liked to be, he wanted to be, and he could conceive no other life.

The social pattern of the Gurrow Grouping is difficult to grasp unless born into it, but there was a looseness about it that almost made the word "pattern" incongruous. The individual Gurrow took whatever job he felt an aptitude for, and such work as was left over and needed to be done was done either in com-

mon, or consecutively by each according to an order determined by lot. Put so, it sounds too simple to work, but actually the traditions that had gathered with the five thousand years since the first Voluntary Grouping of Gurrahs was supposed to have been established, made the system complicated, flexible—and workable.

The Recorder was, as Raph had anticipated, at his home, and there was the embarrassment of renewing an old and unjustly neglected acquaintanceship. He had made use of the Recorder's reference library, of course, but always indirectly—yet he had once been a child, an intimate learner at the feet of accumulated wisdom, and he had let the intimacy lapse.

The room he now entered was more or less choked with recordings and, to a lesser degree, with printed material. The Recorder interspersed greetings with apologies.

"Shipments have come from some of the other Groupings," he said. "It needs time for cataloguing, you know, and I can't seem to find the time I used to." He lit a pipe and puffed strongly. "Seems to me I'll have to find a full-time assistant. What about your son, Raph? He clusters about here the way you did twenty years ago?"

"You remember those times?"

"Better than you do, I think. Think your son would like that?"

"Suppose you talk to him. He might like to. I can't honestly say he's fascinated by archaeology." Raph picked up a recording at random and looked at the identification tag: "Um-m-m—from the Joquin Valley Grouping. That's a long way from here."

"A long way." The Recorder nodded. "I have sent them some of ours, of course. The works of our own Grouping are highly regarded throughout the continent," he said, with proprietary pride. "In fact"—he pointed the stem of his pipe at the other—"your own treatise on extinct primates has been distributed everywhere. I've sent out two thousand copies and there are still requests. That's pretty good—for archaeology."

"Well, archaeology is why I am here—that and what my son says you've been telling him." Raph had a little trouble starting: "It seems you have spoken of creatures called Eekahs from the Antipodes, and I would like to have such information as you have on them."

The Recorder looked thoughtful: "Well, I could tell you what I know offhand, or we could go to the Library and look up the references."

"Don't bother opening the Library for me. It's a Closed-Day. Just give me some notion of things and I'll search the references later."

The Recorder bit at his pipe, shoved his chair back against the wall and de-focused his eyes thoughtfully. "Well," he said, "I suppose it starts with the discovery of the continents on the other side. That was five years ago. You know about that, perhaps?"

"Only the fact of it. I know the continents exist, as everyone does now. I remember once speculating on what a shining new field

it would be for archaeological research, but that is all."

"Ah, then there is much else to tell you of. The new continents were never discovered by us directly, you know. It was five years ago that a group of non-Gurrow creatures arrived at the East Harbor Grouping in a machine that flew—by definite scientific principles, we found out later, based essentially on the buoyancy of air. They spoke a language, were obviously intelligent, and called themselves Eekahs. The Gurrows, of the East Harbor Grouping learned their language—a simple one though full of unpronounceable sounds—and I have a grammar of it, if you're interested—"

Ralph waved that away.

The Recorder continued: "The Gurrows of the Grouping, with the aid of those of the Iron Mountain Grouping—which specialize in steel works, you know—built duplicates of the flying machine. A flight was made across the ocean, and I should say there are several dozens of volumes on all that—volumes on the flying machine, on a new science called aerodynamics, new geographies, even a new system of philosophy based on the plurality of intelligences. All produced at the East Harbor and Iron Mountain Groupings. Remarkable work for only five years, and all are available here."

"But the Eekahs—are they still at the East Harbor Groupings?"

"Um-m-m. I'm pretty certain they are. They refused to return to their own continents. They call themselves 'political refugees.'"

"Politi . . . *what?*".

"It's their own language," said the Recorder, "and it's the only translation available."

"Well, why *political* refugees? Why not geological refugees, or oompah refugees. I should think a translation ought to make sense."

The Recorder shrugged: "I refer you to the books. They're not criminals, they claim. I know only what I tell you."

"Well, then, what do they look like? Do you have pictures?"

"At the Library."

"Did you read my 'Principles of Archaeology?'"

"I looked through it."

"Do you remember the drawing of Primate Primeval."

"I'm afraid not."

"Then, look, let's go down to the Library, after all."

"Well, sure." The Recorder grunted as he rose.

The Administrator of the Red River Gurrow Grouping held a position in no way different in essentials from that of the Museum Curator, the Recorder or any other voluntary job holder. To expect a difference is to assume a society in which executive ability is rare.

Actually, all jobs in a Gurrow Grouping—where a "job" is defined as regular work, the fruits of which adhere to others in addition to the worker himself—are divided into two classes: one, Voluntary Jobs and the other, Involuntary or Community Jobs. All of the first classi-

fication are equal. If a Gurrow enjoys the digging of useful ditches, his bent is to be respected and his job to be honored. If no one enjoys such burrowing and yet it is found necessary for comfort, it becomes a Community Job, done by lot or rotation according to convenience—annoying but unavoidable.

And so it was that the Administrator lived in a house no more ample and luxurious than others, sat at the head of no tables, had no particular title other than the name of his job, and was neither envied, hated, nor adored.

He liked to arrange Inter-Group trade, to supervise the common finances of the Group, and to judge the infrequent disagreements that arose. Of course, he received no additional food or energy privileges for doing what he liked.

It was not, therefore, to obtain permission, but to place his accounts in decent order, that Raph stopped in to see the Administrator. The Closed-Day had not yet ended. The Administrator sat peacefully in his after-dinner armchair, with an after-dinner cigar in his mouth, and an after-dinner book in his hand. Although there was something rather timeless about six children and a wife, even they had an after-dinner air about them.

Raph received a multiple greeting upon entering, and raised two hands to his ears, for if the various Administratelets (Only applicable title. Author.) had a job, it was noise-making. Certainly, it was what they liked to do, and certainly others reaped most of the fruits therefrom, for their own eardrums were apparently impervious.

The Administrator shooed them.

Raph accepted a cigar.

"I intend leaving the Grouping for a time, Lahr," he said. "My job necessitates it."

"We won't enjoy your going, Raph. I hope it will not be for long."

"I hope not. What have we in Common Units?"

"Oh, ample for your purposes, I'm sure. Where do you intend going?"

"To the East Harbor Grouping."

The Administrator nodded and blew out a thoughtful puff of smoke: "Unfortunately, East Harbor has a surplus in their favor registered in our books—I can verify that, if you wish—but the Common Units of Exchange on hand will take care of transportation and necessary expenses."

"Well, that's fine. But tell me, what is my status on the Community Job Roster?"

"Um-m-m— I'll have to get the rolls. You'll excuse me a moment." He trundled away, heaving his great weight across the room and out into the hallway. Raph paused to poke at the youngest of the children who rolled up to him, growling in mock ferocity with gleaming teeth—a black little bundle of thick fur, with the long, childish snout that had not yet broadened away from the shape of the animal ancestry of half a million years earlier.

The Administrator returned with a heavy ledger and large spectacles. He opened the ledger meticulously, ruffled the pages to the proper place and then drew a careful finger down the columns.

He said: "There's only the question of the water supply, Raph. You're due on the Maintenance gang for this next week. There's nothing else due for at least two months."

"I'll be back before then. Is there any chance of someone subbing for me on the Water Maintenance?"

"Um-m-m— I'll get someone. I can always send my oldest. He's getting to job age and he might as well taste everything. He may like working on the dam."

"Yes? You tell me if he does, then. He can replace me, regularly."

The Administrator smiled gently: "Don't plan on that, Raph. If he can figure out a way of making sleeping useful to all of us, he'll certainly take it up as a job. And why are you going to East Harbor Grouping, by the way, if it's something you care to talk about?"

"You'll laugh, perhaps, but I have just found out that there exist such things as Eekahs."

"Eekahs? Yes, I know." The Administrator pointed a finger. "Creatures from across the sea! Right?"

"Right! But that's not all. I've come from the Library. I've seen trimensional reproductions, Lahr, and they're *Primate Primeval*, or almost. They're primates, anyway, *intelligent* primates. They've got small eyes, flat noses, and completely different jawbones—but they're at least second cousins. I've *got* to see them, Lahr."

The Administrator shrugged. He felt no interest in the matter himself. "Why? I ask out of ignorance, Raph. Does it matter, your seeing them?"

"Matter?" Raph was obviously appalled at the question. "Don't you know what's been going on these last years? Have you read my archaeology book?"

"No," said the Administrator, definitely, "I wouldn't read it to save myself a turn at Garbage Disposal."

Raph said: "Which probably proves you more suited to Garbage Disposal than archaeology. But never mind. I've been fighting singlehanded for nearly ten years in favor of my theory that Primate Primeval was an intelligent creature with a developed civilization. I have nothing on my side so far but logical necessity, which is the last thing most archaeologists will accept. They want something solid. They want the remains of a Grouping, or artifacts, structures, books—get it. All I can give them is a skeleton with a huge brain-pan. Stars above, Lahr, what do they expect to survive in ten million years.. Metal dies. Paper dies. Film dies.

"Only stone lasts, Lahr. And bone that's turned to stone. I've got that. A skull with room for a brain. And stone, too, old sharpened knives. Ground flints."

"Well," said Lahr, "there are your artifacts."

"Those are called eoliths, dawn stones. They won't accept them. They call them natural products, fortuitously shaped by erosion into the shapes they have, the idiots."

Then he grinned with a scientific ferocity: "But if the Eekahs are intelligent primates, I've practically proven my case."

Raph had traveled before, but never eastward, and the decline of agriculture on the road impressed him. In early history, the Gurrow Groupings had been entirely unspecialized. Each had been self-sufficient and trade was a gesture of friendliness rather than a matter of necessity.

And so it was still in most Groupings. His own Grouping, the Red River, was perhaps typical. Some five hundred miles inland, set in lush farm land, agriculture remained centric. The river yielded some fish and there was a well-developed dairy industry. In fact, it was food exports that provided cause for the healthy state of the store of Common Units.

As they traveled eastward, however, the Groupings through which they passed paid less and less mind to the shallowing soil and more and more to the smoking factory structures.

In the East Harbor Grouping, Raph found a trading center which depended for its prosperity primarily upon ships. It was a more populous Grouping than the average, more densely packed, with houses, on occasion, within a hundred yards of each other.

Raph felt an uncomfortable prickling at the thought of living in such close quarters. The docks were even worse, with Gurrows engaged at the huge Community Jobs of loading and unloading.

The Administrator of this East Harbor Grouping was a young man, new at his job, overwhelmed with the joy of his work, and beside himself with the pleasure of welcoming a distinguished stranger.

Raph sat through an excellent meal, and was treated to a long discourse as to the exact derivation of each dish. To his provincial ears, beef from the Prairie Grouping, potatoes from the Northeast Woods Grouping, coffee from the Isthmus Grouping, wine from the Pacific Grouping, and fruit from the Central Lakes Grouping were something strange and wonderful.

Over the cigars—South Island Grouping—he brought up the subject of the Eekahs. The East Harbor Administrator grew solemn and a little uneasy.

"The man you want to see is Lernin. He'll be glad to help you all he can. You say you know something of these Eekahs?"

"I say I would *like* to know something. They resemble an extinct species of animal I am familiar with."

"Then *that* is your field of interest. I see."

"Perhaps you can tell me some of the details of their arrival, Administrator," suggested Raph, politely.

"I was not Administrator at the time, friend, so that I lack first-hand information, but the records are plain. This group of Eekahs that arrived in their flying-machine . . . you've heard about these aeronautical devices?"

"Yes, yes."

"Yes. Well . . . apparently they were fugitives."

"So I have heard. Yet they claim not to be criminals. Isn't that so?"

"Yes. Queer, isn't it. They admitted that they had been condemned—this was after long and skillful questioning once we had learned their language—but denied that they were evildoers. Apparently, they had disagreed with their Administrator on principles of policy."

Raph nodded his head knowingly: "Ah, and refused to abide by the common decision. Is that it?"

"More confusing than that. They instist there was no common decision. They claim that the Administrator decided on policy of his own accord."

"And was not replaced?"

"Apparently those who believe he should are considered criminals—as these were."

There was a frank pause of disbelief. Then Raph said: "Does that sound reasonable to you?"

"No, I merely relay to you their words. Of course, the Eekah language is quite a barrier. Some of the sounds can't be pronounced: words have different meanings according to position in the sentence and according to tiny differences in inflection. And it happens often that Eekah words even when best translated are a complete puzzle."

"They must have been surprised to find Gurrows here," suggested Raph, "if they are members of a different genus."

"Surprised!" The Administrator's voice sank: "I'll say they were surprised. Now this information has not been generally published for obvious reasons, so I hope you remember that it's confidential. These Eekahs killed five Gurrows before they could be disarmed. They had an instrument that expelled metal pellets at high speed by means of a controlled explosive chemical reaction. We have duplicated it since. Naturally, under the circumstances, we are not branding them criminals, for it is reasonable to assume that they did not realize we were intelligent beings. Apparently," and the Administrator smiled ruefully, "we resemble certain animals in their world. Or so they say."

But Raph was galvanized into a sudden enthusiasm: "Stars above! They said that, did they? Did they go into details? What kind of animals?"

The Administrator was taken back: "Well, I don't know. They give names in their language. What meaning has that? They called us giant 'bears.'"

"Giant what?"

"Bears. I haven't the slightest idea what they are, except presumably that they look like us. I know of no such in America."

"Bears. Bears." Raph stumbled

over the word. "That's interesting. It's more than interesting. It's stupendous. Do you know, Administrator, that there is great dispute among us as to the ancestry of Gurrows? Living animals related to Gurrow sapiens would be of immense importance." Raph rubbed his huge hands with pleasure.

The Administrator was pleased at the sensation he had caused. He said: "And a puzzling thing in addition is that they call themselves by two names."

"Two names?"

"Yes. No one knows the distinction yet, no matter how much the Eekahs explain it to us, except that one is a more general name, and one a more specific. The basis of the difference escapes us."

"I see. Which is 'Eekah'?"

"That is the specific one. The general one is"—the Administrator stumbled slowly over the harsh syllables — "Chim-pan-zee. There, that's it. There are a group called Eekahs and there are other groups with other names. But they are all called Chim . . . what I said before."

The Administrator sought through his mind for other juicy items of miscellany with which he was acquainted, but Raph interrupted him.

"May I see Lernin tomorrow?"

"Of course."

"Then I shall do so. Thank you for your courtesy, Administrator."

Lernin was a slight individual. It is doubtful if he weighed more than two hundred and fifty. There was also an imperfection in his walk, a slight lameness. But neither of these facts made much of an impression on Raph once the conversation had begun, for Lernin was a thinker who could impose his vigor upon others.

It was Raph whose eagerness dominated the first half of the conversation, and Lernin's comments were as luminous and as brief as lightning flashes. And then, there was a sudden whirl of the center of gravity, and Lernin took over.

"You will excuse me, learned friend," Lernin said with a characteristic stiffness that he could make so amiable, "if I find your problem unimportant. No, no"—he lifted a long-fingered hand—"not, in the uncomplicated talk of the times, merely unimportant to myself because my interest lies elsewhere, but unimportant to the Grouping of all the Groupings—to every single Gurrow from end to end of the world."



The concept was staggering. For a moment, Raph was offended; offended deep in his sense of individuality. It showed in his face.

Lernin added quickly: "It may sound impolite, crude, uncivilized. But I must explain. I must explain because you are primarily a social scientist and will understand—perhaps better than we ourselves."

"My life-interest," said Raph angrily, "is important to myself. I cannot assume those of others in preference."

"What I talk about should be the life-interest of all—if only because it may be the means of saving the lives of all of us."

Raph was beginning to suspect all sorts of things from a queer form of joking to the unbalance of mind that sometimes came with age. Yet Lernin was not old.

Lernin said, with an impressive fervor: "The Eekahs of the other world are a danger to us, for they are not friendly to us."

And Raph replied naturally: "How do you know?"

"No one other than myself, my friend, has lived more closely with these Eekahs who have arrived here, and I find them people with minds of emotional content strange to us. I have collected queer facts which we find difficult to interpret, but which point, at any rate, in disquieting directions.

"I'll list a few. Eekahs in organized groups kill one another periodically for obscure reasons. Eekahs find it impossible to live in manner other than those of ants—that is, in huge conglomerate societies—yet find it impossible to allow for the presence of one another. Or, to use the terminology of the social scientists, they are gregarious without being social, just as we Gurrows are social without being gregarious. They have elaborate codes of behavior, which, we are told, are taught to the young, but which are disobeyed in universal practice, for reasons obscure to us. Et cetera. Et cetera. Et cetera."

"I am an archaeologist," said Raph, stiffly. "These Eekahs are of interest to me biologically only. If the curvature of the thigh bone is known to me, I care little for the curvature of their cultural processes. If I can follow the shape of the skull, it is immaterial to me that the shape of their ethics is mysterious."

"You don't think that their insanities may affect us here."

"We are six thousand miles apart, or more, along either ocean," said Raph. "We have our world. They have theirs. There is no connection between us."

"No connection," mused Lernin, "so others have said. No connection at all. Yet Eekahs have reached us, and others may follow. We are told that the other world is dominated by a few, who are in turn dominated by their queer need for security which they confuse with an Eekah word called 'power' which, apparently, means the prevailing of one's own will over the sum of the will of the community. What if this 'power' should extend to us?"

Raph bent his mind to the task.

The matter was utterly ridiculous. It seemed impossible to picture the strange concepts.

Lernin said: "These Eekahs say that their world and ours in the long past were closer together. They say that there is a well-known scientific hypothesis in their world of a continental drift. That may interest you since otherwise you might find it difficult to reconcile the existence of fossils of Primate Primeval closely related to living Eekahs six thousand miles away."

And the mists cleared from the archaeologist's brain as he glanced up with a live interest untroubled by insanities: "Ah, you should have said this sooner."

"I say it now as an example of what you may achieve for yourself by joining us and helping us. There is another thing. These Eekahs are physical scientists, like ourselves here in East Harbor, but with a difference dictated by their own cultural pattern. Since they live in hives, they think in hives, and their science is the result of an ant-society. Individually, they are slow and unimaginative; collectively, each supplies a crumb different from that supplied by his fellow—so that a vast structure is erected quickly. Here the individual is infinitely brighter, but he works alone. You, for instance, know nothing of chemistry, I imagine."

"A few of the fundamentals, but nothing else," admitted Raph. "I leave that, naturally, to the chemist."

"Yes, naturally. But I *am* a chemist. Yet these Eekahs, though my mental inferiors, and no chemists in their own world, know more chemistry than I. For instance, did you know that there exist elements that spontaneously disintegrate?"

"Impossible," exploded Raph. "Elements are eternal, changeless—"

Lernin laughed: "So you have been taught. So I have been taught. So I taught others. Yet the Eekahs are right, for in my laboratories, I have checked them, and in every detail they are right. Uranium gives rise to a spontaneous radiation. You've heard of uranium, of course? And furthermore, I have detected radiations of energy beyond that produced by uranium which must be due to traces of elements unknown to us but described by the Eekahs. And these missing elements fit well into the so-called Periodic Tables some chemists have tried to foist upon the science. Though I do wrong to use the word 'foist' now."

"Well," said Raph, "why do you tell me this? Does this, too, help me in my problem."

"Perhaps," said Lernin, ironically, "you will yet find it a royal bribe. You see the energy production of uranium is absolutely constant. No known outward change in environment can affect it—and as a result of the loss in energy, uranium slowly turns to lead at an *absolutely constant rate.* A group of our men is even now using this fact as a basis for a method of determining the age of the earth. You see, to determine the age of a stratum of rock in the earth then,

it is but necesary to discover a region in it containing a trace of uranium—a widely spread element—and to determine about it the quantity of lead—and I might here add that the lead produced from uranium differs from ordinary lead and can be easily characterized—and it is then simple to determine the length of time in which that stratum has been solid. And of course, if a fossil is found in that stratum, it is of the same age, am I not correct?"

"Stars above," and Raph rose to his feet in a tremble, "you do not deceive me? It is really possible to do this?"

"It is possible. It is even easy. I tell you that our great defense, even at this late date, is co-operation in science. We are a group now of many, my friend, from many Groupings and we want you among us. If you join us, it would be a simple matter to extend our earth-age project to such regions as you may indicate—regions rich in fossils. What do you say?"

"I will help you."

It is doubtful if the Gurrow Groupings had ever before seen a community venture of such breadth as now took place. East Harbor Grouping, as has been remarked, was a shipping center and certainly, a trans-Atlantic vessel was not beyond the capacity of a Grouping that traded along the full lengths of both coasts of the Americas. What *was* unusual was the vastness of the co-operation of Gurrows from many Groupings, Gurrows of many interests.

Not that they were all happy.

Raph, for instance, on the particular morning that now concerns us, six months from the date of his first arrival in East Harbor, was searching anxiously for Lernin.

Lernin, for his part, was searching for nothing but greater speed.

They met on the docks, where Lernin, biting the end off a cigar and leading the way to a region where smoking was permitted, said: "And you, my friend, seem concerned. Not, certainly, about the progress of our ocean liner?"

"I am concerned," said Raph, gravely, "about the report I have received of the expedition testing the age of the rocks."

"Oh— And you are unhappy about it?"

"Unhappy!" exploded Raph. "Have you seen them?"

"I have received a copy. I have looked at it. I have even read parts of it. But I have had little time and most of it bounced off. Will you please enlighten me?"

"Certainly. In the last several months, three of the regions I have indicated as being fossiliferous have been tested. The first region was in the area of East Harbor Grouping itself. Another was in the Pacific Bay Grouping, and a third in the Central Lakes Grouping. I purposely asked that those be done first because they are the richest areas and because they are widely separated. Do you know, for instance, what age they tell me the rocks upon which we stand are?"

"Two billion years, I think, is the oldest figure I noticed."

"And that's the figure for the oldest rocks—the basic igneous stratum of basalt. The upper strata, however—the recent sedimentary layers containing dozens of fossils of Primate Primeval—how old do you think *these* are supposed to be? Five—hundred—trillion — years! How is that? Do you understand?"

"Trillion?" Lernin squinted upwards and shook his head. "That's strange."

"I'll add to it. The Pacific Coast Grouping is one hundred trillion years old—so I am told—and Central Lakes almost eighty trillion years old."

Lernin said: "And the other measurements? The ones that did not involve your strata?"

"That is the most peculiar thing of all. Most of the chosen investigations were carried on in strata that were not particularly fossiliferous. They had their own criteria of choice based on geological reasoning—and they got consistent results—one million to two billion years depending upon the depth and geological history of the particular region tested. Only *my* areas give these strange and impossible vagaries."

And Lernin said. "But what do the geologists say about all this. Can there be some error?"

"Undoubtedly. But they have fifty decent, reasonable measurements. For themselves, they have proved the method and are happy. There are three anomalies, to be sure, but they view them with equanimity as involving some unknown factors. I don't see it that way. These three measurements mean everything." Raph interrupted himself fiercely: "How sure are you that radioactivity is an absolute constant."

"Sure? Can one ever be sure? Nothing we know of so far affects it, and such is likewise the definite testimony of our Lekahs. Besides, my friend, if you are implying that radioactivity was more extensive in the past than in the present, why only in your fossil regions? Why not everywhere?"

"Why, indeed? It's another aspect of a problem which is growing more important daily. Consider. We have regions which show a past of abnormal radioactivity. We have regions which show abnormal fossil frequencies. Why should these regions coincide, Lernin?"

"One obvious answer suggests itself, my friend. If your Primate Primeval existed at a time when certain regions were highly radioactive, certain individuals would wander into them and die. Radioactive radiation is deadly in excess, of course. Radioactivity and fossils, there you are."

"Why not other creatures," demanded Raph. "Only Primate Primeval occurs in excess, and he was intelligent. He would not be trapped by dangerous radiation."

"Perhaps he was not intelligent. That is, after all, only your theory and not a proven fact."

"Certainly then he was more intelligent than his small-brained contemporaries."

"Perhaps not even that. You romanticize too much."

"Perhaps I do." Raph spoke in half a whisper. "It seems to me that I can conjure up visions of a great civilization of a million years back—or more. A great power; a great intelligence—that has vanished completely, except for the tiny whispers of ossified bones which retain that huge cavity in which a brain once existed, and a bony five-fingered hand curving into slender signs of manipulative skill—with an opposing thumb. They *must* have been intelligent."

"Then what killed them?" Lernin shrugged: "Several million species of living things have survived."

Raph looked up, half in anger: "I cannot accompany your group, Lernin, on a Voluntary basis. To go to the other world would be useful, yes, if I could engage in my own studies. For your purposes, it can be only a Community Job to me. I cannot give my heart to it."

But Lernin's jaw was set: "That arrangement would not be fair. There are many of us, my friend, who are sacrificing our own interests. If we all placed them first and investigated the other world in terms of our own particular provincialisms only, our great purpose would be destroyed. My friend, there is not one of our men that we can spare. We must all work as if our lives depended on our instant solution of the Eekah problem, which, believe me, it does."

Raph's jaws twisted in distaste. "On your side, you have a vague apprehension of these weak, stupid little creatures. On my side I have a definite problem of great intellectual attraction to myself. And between the two I can see no connection—no possible connection at all."

"Nor can I. But listen to me a moment. A small group of our most trusted men returned last week from a visit to the other world. It was not official, as ours will be. It made no contacts. It was a frank piece of espionage, which I am telling you about now. I ask your discretion on the matter."

"Naturally."

"Our men possessed themselves of Eekah event-sheets."

"Pardon me?"

"It is a created name to describe the objects. Printed records are issued daily in the various centers of Eekah population of events and occurrences of the day, and what passes for literary efforts as well."

Raph was momentarily interested: "It strikes me as an excellent idea."

"Yes, in its essence. The Eekah notion of interesting events, however, appears to consist entirely of antisocial events. However, leave that be. My point is that the existence of the Americas is well-known there these days—and it is universally spoken of as a 'new land of opportunity.' The various divisions of Eekahs eye it with a universal desire. The Eekahs are many, they are crowded, their economy is irrational. They want new land, and that is what this is to them—new and empty land."

"Not empty," pointed out Raph, mildly.

"Empty to them," insisted Lernin terribly. "That is the vast danger. Lands occupied by Gurrows are to them empty and they mean to take it, all the more so since they have often enough striven to take the lands of one another."

Raph shrugged: "Even so, they—"

"Yes. They are weak and stupid. You said that, and so they are. But only singly. They will unite for a purpose. To be sure, they will fall apart when the purpose is done—but momentarily they will join and become strong, which we perhaps cannot do, witness yourself. And their weapons of war have been keened in the fire of conflict. Their flying machines, for instance, are superb war weapons."

"But we have duplicated it—"

"In quantity? We have also duplicated their chemical explosives, but only in the laboratory, and their firing tubes and armored vehicles, but only in experimental plants. And yet there is more—something developed within the last five years, for our own Eekahs know nothing about it."

"And what is that?"

"We don't know. Their event-sheets speak of it—the names applied to it mean nothing to us—but the context implies the terror of it, even on the part of these kill-mad Eekahs. There seems no evidence that it has been used, or that all the Eekah groups have it—but it is used as a supreme threat. It will perhaps be clearer to you when all the evidence is presented once our voyage is under way."

"But what is it? You talk of it as if it were a bogey."

"Why, *they* talk of it as if it were a bogey. And what *could* be a bogey to an Eekah? That is the most frightening aspect of it. So far we know only that it involves the bombardment of an element they call plutonium—of which we have never heard and of which our own Eekahs have never heard either—by objects called neutrons, which our Eekahs say are subatomic particles without charge, which seems to us completely ridiculous."

"And that is all?"

"All. Will you suspend judgment till we show you the sheets?"

Raph nodded reluctantly: "Very well."

Raph's leaden thoughts revolved in their worn groove as he stood there alone.

Eekahs and Primate Primeval. A living creature of erratic habits and a dead creature that must have aspired to heights. A sordid present of explosives and neutron bombardments and a glorious, mysterious past—

No connection! No connection!

THE END.

THAT ONLY A MOTHER

BY JUDITH MERRIL

A new feminine science-fiction author gives a slightly different slant on one of the old themes —and a brilliantly bitter little story results.

Illustrated by Alejandro

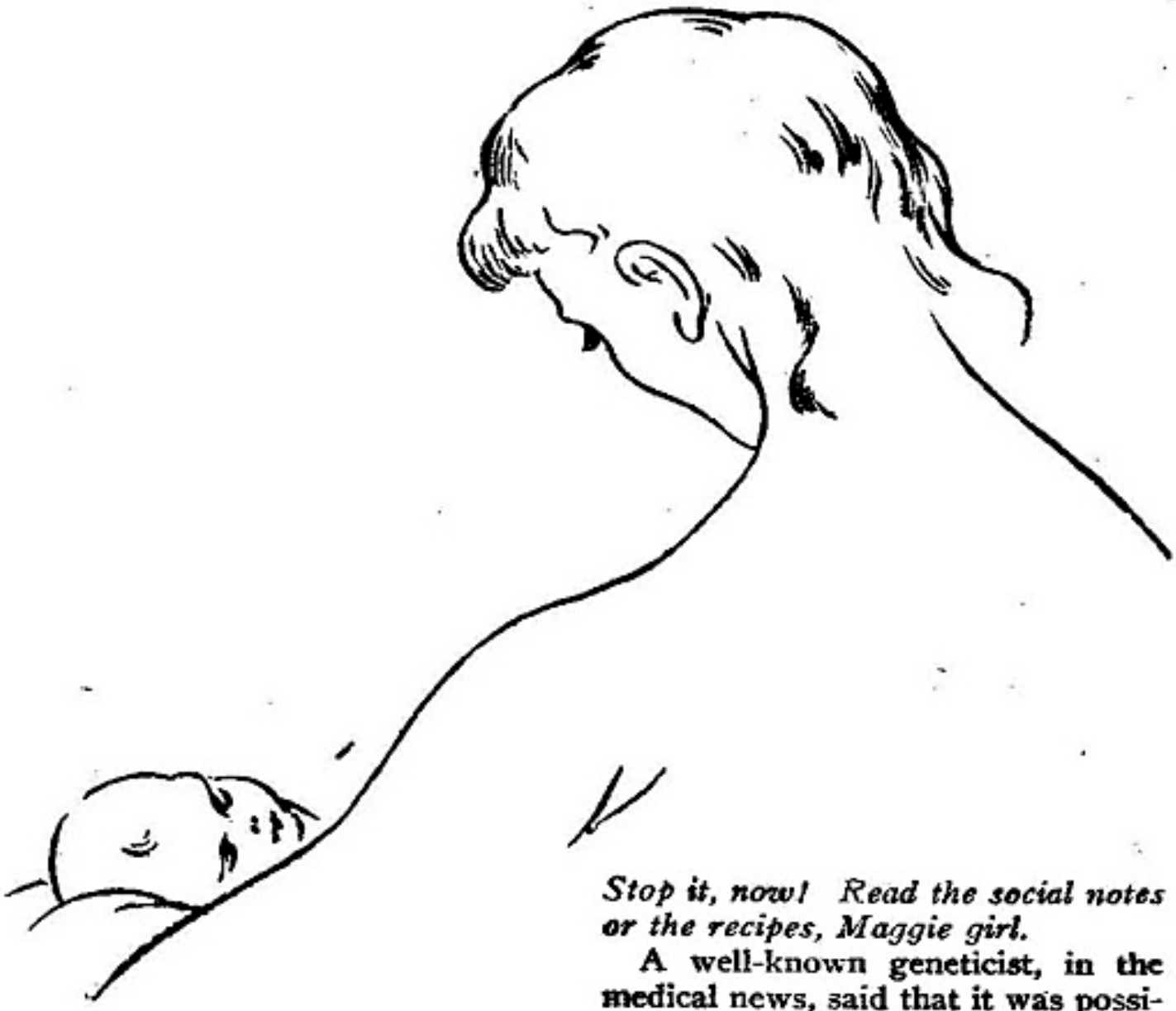
Margaret reached over to the other side of the bed where Hank should have been. Her hand patted the empty pillow, and then she came altogether awake, wondering that the old habit should remain after so many months. She tried to curl up, cat-style, to hoard her own warmth, found she couldn't do it any more, and climbed out of bed with a pleased awareness of her increasingly clumsy bulkiness.

Morning motions were automatic. On the way through the kitchenette, she pressed the button that would start breakfast cooking—the doctor had said to eat as much breakfast as she could—and tore the paper out of the facsimile machine. She folded the long sheet carefully to the "National News" section, and propped it on the bathroom shelf to scan while she brushed her teeth.

No accidents. No direct hits. At least none that had been officially released for publication. *Now, Maggie, don't get started on that. No accidents. No hits. Take the nice newspaper's word for it.*

The three clear chimes from the kitchen announced that breakfast was ready. She set a bright napkin and cheerful colored dishes on the table in a futile attempt to appeal to a faulty morning appetite. Then, when there was nothing more to prepare, she went for the mail, allowing herself the full pleasure of prolonged anticipation, because today there would *surely* be a letter.

There was. There were. Two bills and a worried note from her mother: "Darling, why didn't you write and tell me sooner? I'm thrilled, of course, but, well one hates to mention these things, but are you *certain* the doctor was right? Hank's been around all that uranium or thorium or whatever it is all these years, and I know you say he's a designer, not a technician, and he doesn't get near anything that might be dangerous, but you know he used to, back at Oak Ridge. Don't you



think . . . well, of course, I'm just being a foolish old woman, and I don't want you to get upset. You know much more about it than I do, and I'm sure your doctor was right. He *should* know . . ."

Margaret made a face over the excellent coffee, and caught herself refolding the paper to the medical news.

Stop it, Maggie, stop it! The radiologist said Hank's job couldn't have exposed him. And the bombed area we drove past . . . No, no. Stop it, now! Read the social notes or the recipes, Maggie girl.

A well-known geneticist, in the medical news, said that it was possible to tell with absolute certainty, at five months, whether the child would be normal, or at least whether the mutation was likely to produce anything freakish. The worst cases, at any rate, could be prevented. Minor mutations, of course, displacements in facial features, or changes in brain structure could not be detected. And there had been some cases recently, of normal embryos with atrophied limbs that did not develop beyond the seventh or eighth month. But, the doctor concluded cheerfully, the *worst* cases

could now be predicted and prevented.

"Predicted and prevented." We predicted it, didn't we? Hank and the others, they predicted it. But we didn't prevent it. We could have stopped it in '46 and '47. Now . . .

Margaret decided against the breakfast. Coffee had been enough for her in the morning for ten years; it would have to do for today. She buttoned herself into the interminable folds of material that, the salesgirl had assured her, was the *only* comfortable thing to wear during the last few months. With a surge of pure pleasure, the letter and newspaper forgotten, she realized she was on the next to the last button. It wouldn't be long now.

The city in the early morning had always been a special kind of excitement for her. Last night it had rained, and the sidewalks were still damp-gray instead of dusty. The air smelled the fresher, to a city-bred woman, for the occasional pungency of acrid factory smoke. She walked the six blocks to work, watching the lights go out in the all-night hamburger joints, where the plate-glass walls were already catching the sun, and the lights go on in the dim interiors of cigar stores and dry-cleaning establishments.

The office was in a new Government building. In the rolovator, on the way up, she felt, as always, like a frankfurther roll in the ascending half of an old-style rotary toasting machine. She abandoned the air-foam cushioning gratefully at the fourteenth floor, and settled down behind her desk, at the rear of a long row of identical desks.

Each morning the pile of papers that greeted her was a little higher. These were, as everyone knew, the decisive months. The war might be won or lost on these calculations as well as any others. The manpower office had switched her here when her old expediter's job got to be too strenuous. The computer was easy to operate, and the work was absorbing, if not as exciting as the old job. But you didn't just stop working these days. Everyone who could do anything at all was needed.

And—she remembered the interview with the psychologist—*I'm probably the unstable type. Wonder what sort of neurosis I'd get sitting home reading that sensational paper . . .*

She plunged into the work without pursuing the thought.

February 18.

Hank darling,

Just a note—from the hospital, no less. I had a dizzy spell at work, and the doctor took it to heart. Blessed if I know what I'll do with myself lying in bed for weeks, just waiting—but Dr. Boyer seems to think it may not be so long.

There are too many newspapers around here. More infanticides all the time, and they can't seem to get a jury to convict any of them. It's the fathers who do it. Lucky thing you're not around, in case—

Oh, darling, that wasn't a very *funny* joke, was it? Write as

often as you can, will you? I have too much time to think— But there really isn't anything wrong, and nothing to worry about.

Write often, and remember I love you.

Maggie.

SPECIAL SERVICE TELEGRAM
February 21, 1953
22:04 LK37G
From: Tech. Lieut. H. Marvell
X47-016 GCNY
To: Mrs. H. Marvell
Women's Hospital
New York City

HAD DOCTOR'S GRAM STOP WILL ARRIVE FOUR OH TEN STOP SHORT LEAVE STOP YOU DID IT MAGGIE STOP LOVE HANK

February 25.

Hank dear,

So you didn't see the baby either? You'd think a place this size would at least have visiplates on the incubators, so the fathers could get a look, even if the poor benighted mommas can't. They tell me I won't see her for another week, or maybe more—but of course, mother always warned me if I didn't slow my pace, I'd probably even have my babies too fast. Why must she *always* be right?

Did you meet that battle-ax of a nurse they put on here? I imagine they save her for people who've already had theirs, and don't let her get too near the prospectives—but a woman like that simply shouldn't be allowed in a maternity ward. She's obsessed with mutations, can't seem to talk about anything else. Oh, well, *ours* is all right, even if it was in an unholy hurry.

I'm tired. They warned me not to sit up so soon, but I *had* to write you. All my love, darling,

Maggie.

February 29.

Darling,

I finally got to see her! It's all true, what they say about new babies and the face that only a mother could love—but it's all there, darling, eyes, ears, and noses —no, only one!—all in the right places. We're so *lucky*, Hank.

I'm afraid I've been a rambunctious patient. I kept telling that hatchet-faced female with the mutation mania that I wanted to *see* the baby. Finally the doctor came in to "explain" everything to me, and talked a lot of nonsense, most of which I'm sure no one could have understood, any more than I did. The only thing I got out of it was that she didn't actually *have* to stay in the incubator; they just thought it was "wiser."

I think I got a little hysterical at that point. Guess I was more worried than I was willing to admit, but I threw a small fit about it. The whole business wound up with one of those hushed medical conferences outside the door, and finally the Woman in White said: "Well, we might as well. Maybe it'll work out better that way."

I'd heard about the way doctors and nurses in these places develop a God complex, and believe me it is as true figuratively as it is literally

that a mother hasn't got a leg to stand on around here.

I *am* awfully weak, still. I'll write again soon. Love,

Maggie.

March 8.

Dearest Hank,

Well the nurse was wrong if she told you that. She's an idiot anyhow. It's a girl. It's easier to tell with babies than with cats, and *I know*. How about Henrietta?

I'm home again, and busier than a betatron. They got *everything* mixed up at the hospital, and I had to teach myself how to bathe her and do just about everything else. She's getting prettier, too. When can you get a leave, a *real* leave?

Love,

Maggie.

May 26.

Hank dear,

You should see her now—and you shall. I'm sending along a reel of color movie. My mother sent her those nighties with drawstrings all over. I put one on, and right now she looks like a snow-white potato sack with that beautiful, beautiful flower-face blooming on top. Is that *me* talking? Am I a doting mother? But wait till you *see* her!

July 10.

. . . Believe it or not, as you like, but your daughter can talk, and I don't mean baby talk. Alice discovered it—she's a dental assistant in the WACs, you know—and when she heard the baby giving out what I thought was a string of gibberish, she said the kid knew words and sentences, but couldn't say them clearly because she has no teeth yet. I'm taking her to a speech specialist.

September 13.

. . . We have a prodigy for real! Now that all her front teeth are in, her speech is perfectly clear and—a new talent now—she can sing! I mean really carry a tune! At seven months! Darling my world would be perfect if you could only get home.

November 19

. . . at last. The little goon was so busy being clever, it took her all this time to learn to crawl. The doctor says development in these cases is always erratic . . .

SPECIAL SERVICE TELEGRAM
December 1, 1953
08:47 LK59F

From: Tech. Lieut. H. Marvell
X47-016 GCNY

To: Mrs. H. Marvell
Apt. K-17
504 E. 19 St.
N.Y. N.Y.

WEEK'S LEAVE STARTS TOMORROW STOP WILL ARRIVE AIRPORT TEN OH FIVE STOP DON'T MEET ME STOP LOVE LOVE LOVE HANK

Margaret let the water run out of the bathinette until only a few inches were left, and then loosed her hold on the wriggling baby.

"I think it was better when you were retarded, young woman," she informed her daughter happily. "You *can't* crawl in a bathinette, you know."

"Then why can't I go in the bathtub?" Margaret was used to her child's volubility by now, but every now and then it caught her unawares. She swooped the resistant mass of pink flesh into a towel, and began to rub.

"Because you're too little, and your head is very soft, and bathtubs are very hard."

"Oh. Then when can I go in the bathtub?"

"When the outside of your head is as hard as the inside, brainchild." She reached toward a pile of fresh clothing. "I cannot understand," she added, pinning a square of cloth through the nightgown, "why a child of your intelligence can't learn to keep a diaper on the way other babies do. They've been used for centuries, you know, with perfectly satisfactory results."

The child disdained to reply; she had heard it too often. She waited patiently until she had been tucked, clean and sweet-smelling, into a white-painted crib. Then she favored her mother with a smile that inevitably made Margaret think of the first golden edge of the sun bursting into a rosy pre-dawn. She remembered Hank's reaction to the color pictures of his beautiful daughter, and with the thought, realized how late it was.

"Go to sleep, puss. When you wake up, you know, your *Daddy* will be here."

"Why?" asked the four-year-old mind, waging a losing battle to keep the ten-month-old body awake.

Margaret went into the kitchenette and set the timer for the roast. She examined the table, and got her clothes from the closet, new dress, new shoes, new slip, new everything, bought weeks before and saved for the day Hank's telegram came. She stopped to pull a paper from the facsimile, and, with clothes and news, went into the bathroom, and lowered herself gingerly into the steaming luxury of a scented tub.

She glanced through the paper with indifferent interest. Today at least there was no need to read the national news. There was an article by a geneticist. The same geneticist. Mutations, he said, were increasing disproportionately. It was too soon for recessives; even the first mutants, born near Hiroshima and Nagasaki in 1946 and 1947 were not old enough yet to breed. *But my baby's all right.* Apparently, there was some degree of free radiation from atomic explosions causing the trouble. *My baby's fine. Precocious, but normal.* If more attention had been paid to the first Japanese mutations, he said . . .

There was that little notice in the paper in the spring of '47. That was when Hank quit at Oak Ridge. "Only two or three per cent of those guilty of infanticide are being caught and punished in Japan today . . ." *But* MY BABY'S *all right.*

She was dressed, combed, and ready to the last light brush-on of lip paste, when the door chime sounded. She dashed for the door, and heard, for the first time in eighteen months the almost-forgotten sound of a key turning in the lock before the chime had quite died away.

"Hank!"

"Maggie!"

And then there was nothing to say. So many days, so many months, of small news piling up, so many things to tell him, and now she just stood there, staring at a khaki uniform and a stranger's pale face. She traced the features with the finger of memory. The same high-bridged nose, wide-set eyes, fine feathery brows; the same long jaw, the hair a little farther back now on the high forehead, the same tilted curve to his mouth. Pale . . . Of course, he'd been underground all this time. And strange, stranger because of lost familiarty than any newcomer's face could be.

She had time to think all that before his hand reached out to touch her, and spanned the gap of eighteen months. Now, again, there was nothing to say, because there was no need. They were together, and for the moment that was enough.

"Where's the baby?"

"Sleeping. She'll be up any minute."

No urgency. Their voices were as casual as though it were a daily exchange, as though war and separation did not exist. Margaret picked up the coat he'd thrown on the chair near the door, and hung it carefully in the hall closet. She went to check the roast, leaving him to wander through the rooms by himself, remembering and coming back. She found him, finally, standing over the baby's crib.

She couldn't see his face, but she had no need to.

"I think we can wake her just this once." Margaret pulled the covers down, and lifted the white bundle from the bed. Sleepy lids pulled back heavily from smoky brown eyes.

"Hello." Hank's voice was tentative.

"Hello." The baby's assurance was more pronounced.

He had heard about it, of course, but that wasn't the same as hearing it. He turned eagerly to Margaret. "She really can—?"

"Of course she can, darling. But what's more important, she can even do nice normal things like other babies do, even stupid ones. Watch her crawl!" Margaret set the baby on the big bed.

For a moment young Henrietta lay and eyed her parents dubiously.

"Crawl?" she asked.

"That's the idea. Your Daddy is new around here, you know. He wants to see you show off."

"Then put me on my tummy."

"Oh, of course." Margaret obligingly rolled the baby over.

"What's the matter?" Hank's voice was still casual, but an undercurrent in it began to charge the air of the room. "I thought they turned over first."

"This baby," Margaret would not notice the tension, "*This* baby does things when she wants to."

This baby's father watched with softening eyes while the head advanced and the body hunched up, propelling itself across the bed.

"Why the little rascal," he burst into relieved laughter. "She looks like one of those potato-sack racers they used to have on picnics. Got her arms pulled out of the sleeves already." He reached over and grabbed the knot at the bottom of the long nightie.

"I'll do it, darling." Margaret tried to get there first.

"Don't be silly, Maggie. This may be *your* first baby, but *I* had five kid brothers." He laughed her away, and reached with his other hand for the string that closed one sleeve. He opened the sleeve bow, and groped for an arm.

"The way you wriggle," he addressed his child sternly, as his hand touched a moving knob of flesh at the shoulder, "anyone might think you were a worm, using your tummy to crawl on, instead of your hands and feet."

Margaret stood and watched, smiling. "Wait till you hear her sing, darling—"

His right hand traveled down from the shoulder to where he thought an arm would be, traveled down, and straight down, over firm small muscles that writhed in an attempt to move against the pressure of his hand. He let his fingers drift up again to the shoulder. With infinite care, he opened the knot at the bottom of the nightgown. His wife was standing by the bed, saying: "She can do 'Jingle Bells,' and—"

His left hand felt along the soft knitted fabric of the gown, up towards the diaper that folded, flat and smooth, across the bottom end of his child. No wrinkles. No kicking. *No* . . .

"Maggie." He tried to pull his hands from the neat fold in the diaper, from the wriggling body. "Maggie." His throat was dry; words came hard, low and grating. He spoke very slowly, thinking the sound of each word to make himself say it. His head was spinning, but he had to *know* before he let it go. "Maggie, why . . . didn't you . . . tell me?"

"Tell you what, darling?" Margaret's poise was the immemorial patience of woman confronted with man's childish impetuosity. Her sudden laugh sounded fantastically easy and natural in that room; it was all clear to her now. "Is she wet? I didn't know."

She didn't know. His hands, beyond control, ran up and down the soft-skinned baby body, the sinuous, limbless body. *Oh God, dear God*— his head shook and his muscles contracted, in a bitter spasm of hysteria. His fingers tightened on his child— *Oh God, she didn't know* . .

THE END.

INVERTED ALCHEMY

Or how—and why!—to turn gold into quicksilver!

For centuries, alchemists—supported in their researches by hopeful princes—attempted to transmute base metals to gold. Not until December 2, 1942, when the first chain-reacting pile went into action, was it possible to transmute any visible quantity of one element into another. But now, with the aid of the chain-reacting atomic pile, the interchange of mercury and gold—the alchemists always suspected that mercury could be changed into gold, you remember—has been accomplished commercially, with a net profit. Only—the alchemists with reverse English that are doing the job make *gold* into *mercury*. The reasons, and the methods, as described in the National Bureau of Standards report No. 1165 printed below, show how such a transaction can be profitable to Man.

LIGHT WAVE OF MERCURY 198 AS THE ULTIMATE STANDARD OF LENGTH

A new and better standard of length now exists in the wave length of green radiation of mercury 198, an isotope transmuted from gold by neutron bombardment. In precision, reproducibility, and convenience, the new standard is superior to both the standard meter and the red line of cadmium, according to recent investigations by Dr. William F. Meggers of the National Bureau of Standards. Preliminary measurements by Dr. Meggers have shown an accuracy of one part in a hundred million of relative values and one part in a billion is theoretically possible.

Since 1889 the world's standard of length has been the "meter" distance between two lines on a platinum-iridium bar at the International Bureau of Weights and Measures in France. Fundamental measurements throughout all of science and industry are based on this standard, but it has several disadvantages. First, line standards are unsuitable in certain fields of measurement. Second, the intrinsic nature of lines ruled on surfaces—such lines are in effect small furrows—limits the precision attainable. Third, the meter is not readily reproducible.

Primarily because the standard meter does not afford sufficient precision in some fields, the red line of cadmium has been universally

used for many years for precise measurements. However, the cadmium standard also has serious disadvantages. First, there is a fine structure in the red radiation which prevents the line from being as sharp as desirable and thus limits the precision possible. Second, the cadmium standard requires excitation in a furnace which entails unwanted broadening of the spectral line because of relatively high temperature.

The green line of mercury 198 has none of the disadvantages of either the meter or the red line of cadmium. The normal human eye is far more sensitive to green than to red, an important consideration in visual adjustment of the interferometer with which lengths are measured and compared. All other characteristics desirable in a light wave standard—such as ability to be reproduced, absolute sharpness of the wave length, intensity of the spectral line, life and convenience of maintenance—are possessed to a greater extent by mercury 198.

The future refinement of physical optics—for example, an accurate determination of the velocity of light—and the improvement of mechanical processes—for example, the ruling of better diffraction gratings—are dependent on the production and adoption of an ultimate standard of length superior both to the meter bar and to the wave length of red radiation from cadmium. The nuclear reaction that now makes possible large scale transmutation and manufacture of pure elements not found in nature will also produce any desired quantity of the pure mercury from gold, and thus provide a material for a spectroscopic light source that emits light waves much more monochromatic than any emitted by natural elements. Theoretically, mercury isotope 198 should show interference patterns with retardations exceeding a million waves, and because it is possible with monochromatic lines to measure one-one thousandth of a wave, it is probable that the relative value of Hg^{198} wave lengths may eventually be determined with an accuracy of one part in a billion.

As long ago as 1927, the National Bureau of Standards recommended that the International Conference of Weights and Measures adopt a light wave length, that of red radiation from cadmium vapor, as the primary standard of wave length, and that the meter be defined in terms of this wave length. The Conference objected that such a definition of the meter would menace the metric system, and explained that it was not a question of giving a true relation between the meter and the wave length, but only a metric value of the latter which could be modified by future experiments. Strictly speaking, the world's primary standard of length is still the distance between two relatively wide lines drawn on a metal bar, despite the fact that practically all precise measurements of lengths in the Twentieth Century have been made, and will continue to be made, with light waves.

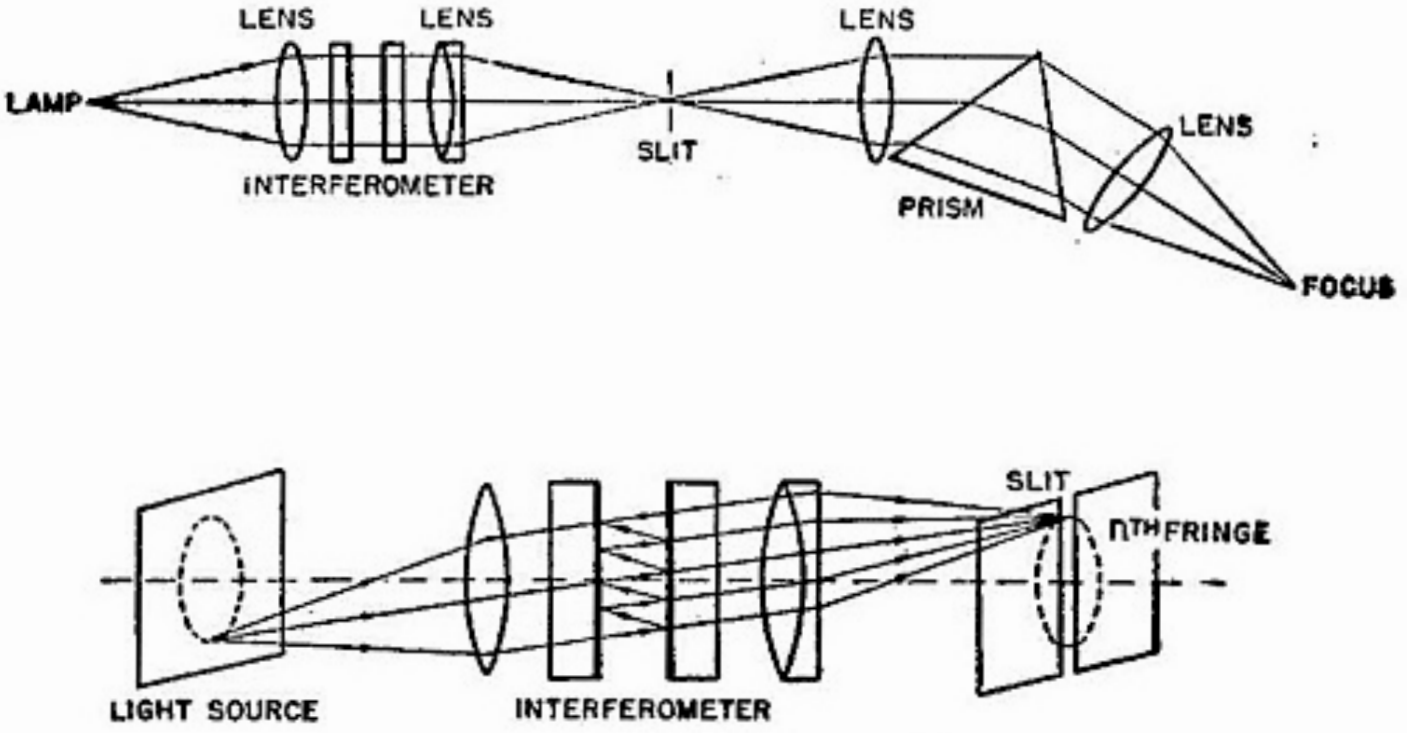
The most monochromatic spectral lines are emitted by massive slow-

moving atoms, and because mercury atoms are nearly twice as heavy as cadmium atoms and can be excited to radiate at less than half the absolute temperature, mercury lines are less than half as wide as cadmium lines, other things being equal. Wave lengths from natural mercury cannot be used as standards of length because natural mercury consists of a fixed mixture of seven isotopes with atomic masses of 196, 198, 199, 200, 201, 202, and 204, and each isotope emits one or more spectral components none of which are exactly coincident. Consequently, the green line of natural mercury has sixteen components.

Because the effective wave length of such a complex line observed interferentially varies with the phase relations of the various components, it is imperative to avoid complex lines in selecting a natural standard of length. This objectionable feature of mercury lines could be removed if a single isotope, for example Hg^{204}, could be separated from the rest, but up to the present it has not been practicable to isolate an isotope of natural mercury in sufficient quantity to make satisfactory lamps. However, this goal has now been achieved by transmuting gold—Au^{197}—into mercury—Hg^{198}. The feasibility of doing this was first demonstrated in 1940 by J. Wiens and L. W. Alvarez who reported that bombardment of gold by neutrons from a sixty-inch cyclotron at the University of California produced enough mercury to be detected spectroscopically.

In 1942, the National Bureau of Standards purchased forty ounces of proof gold and enlisted the cooperation of the University of California to expose this gold to neutrons for one or more years. Unfortunately, World War II interrupted the experiment and only sub-microscopic quantities of artificial mercury were made. The prospects were very discouraging until, near the end of the war, there were rumors of a secret source of neutrons thousands of times more effective than the largest cyclotron. In 1945, the National Bureau of Standards gold was transferred from California to Tennessee. The treatment this gold received was not disclosed but a year later the Bureau distilled from it about sixty milligrams of mercury, which was found from spectroscopic tests by Dr. Meggers, Chief of the Bureau's Spectroscopy Section, to be pure Hg^{198}. Anticipating a considerable demand for Hg^{198} lamps the Bureau has requested the Atomic Energy Commission to bombard some more gold with neutrons to produce one or more grams of Hg^{198} within a year. In the meantime, the available Hg^{198} has been used by Dr. Meggers in the preparation of several types of lamps which are being studied to determine the one most suitable for adoption as a standard.

In the design of a Hg^{198} lamp that will emit radiations suitable as ultimate standards of length a maximum is desirable in each of the following five characteristics: (1) monochromaticity, (2) reproducibility, (3) intensity, (4) life,



A schematic diagram of the train of optical instruments for observing interference patterns of spectral radiations emitted by the source lamp and collected by a lens to illuminate a Fabry-Perot interferometer. Light transmitted by the latter is focused by a corrected lens upon the slit of a prism spectrograph. The latter disperses the light into a spectrum and produces, at its focus, images of the interference patterns that are focused on the slit. The Fabry-Perot interferometer consists of two flat glass plates with adjacent parallel faces silvered or aluminized. Multiple reflections and partial transmissions at the plates produce interference patterns. In the lower diagram, light from one point of an extended light source is traced through the interferometer to its image on the slit. This image will be either light or dark accordingly as the retardation of reflected rays is an even or odd multiple of half wave lengths. The symmetry of this condition about the optical axis forms circular fringes. The total number of waves between the interferometer planes is determined, without counting, from an approximate value, the relative values of their wave lengths, and measurements of their interference patterns.

and (5) convenience. It is perhaps obvious that some of these requirements conflict with others, and that it will be necessary to make compromises. It appears probable that either electrodeless tubes or Geissler tubes—similar to the ubiquitous luminous signs—containing several milligrams of Hg^{198} and a small amount of argon gas will be useful for accurate measurements.

Employing an electrodeless lamp

excited by high frequency radio waves, preliminary values of the wave lengths of a dozen Hg^{198} lines, ranging from the ultraviolet—3341 A—to the yellow—5791 A—have been measured by Dr. Meggers. Though publication of the observed wave lengths of Hg^{198} will be deferred until final values are in hand, these preliminary values, when tested by the combination principle of spectroscopy, appear to be correct within one part in one hundred million, whereas the best measurements made with natural mercury exhibit deviations of one part in one hundred thousand, due, no doubt, to the falsification of the wave lengths by the complexity of the lines.

Although cadmium and mercury are divalent chemical analogues, and therefore exhibit relatively simple and similar atomic spectra, whatever differences exist are invariably in favor of mercury. For example, the brightest line in the cadmium spectrum occurs in the blue-green —5086 A—whereas the mercuric analogue is in the green—5461 A—nearly coincident with the maximum sensitivity of the normal human eye. The red wave of cadmium—6438 A—is intrinsically only one-tenth as intense as the strongest line—5086 A—and is further handicapped by the fact that the eye is only one-seventh as sensitive for red as for green. Thus for the visual adjustment of interferometers the green line of mercury is seventy times as intense as the red line of cadmium. The mercury analogue of the cadmium red line is a yellow line—5791 A—which is always accompanied by another yellow line of shorter wave length—5770 A—but nearly equal intensity. This yellow pair of mercury lines produces interference coincidences at intervals of 275 waves, and is happily heuristic for the whole order of interference without counting any fringes; it has no convenient counterpart in cadmium.

Mercury is the only heavy stable element that has an appreciable vapor pressure below zero degrees Centigrade, and therefore is unique among all elements in radiating, at low pressure and temperature, a relatively simple spectrum of extremely sharp lines provided isotopic structure is eliminated. The green line of mercury, rejected by Michelson fifty years ago on account of complex structure, has finally, by the production of mercury 198, been freed of its seven-isotope curse, and the green line of Hg^{198} now stands alone as the most nearly ideal standard wave length that can ever be obtained from any atoms, natural or artificial. Coupled with the fact that adequate quantities of absolutely pure Hg^{198} are now obtainable by neutron bombardment of gold in chain-reacting piles, the unique properties of Hg^{198} force the conclusions that a progressive scientific world will eventually adopt the wave length of green radiation—5461 A—from Hg^{198} as the ultimate standard of length.

The meter unit, the present unit of length, was created about 1790 to represent one-ten millionth of the earth's quadrant. In 1827, some

natural philosophers meeting in Paris agreed that the meter could not be reproduced if the form of the earth were changed by collision with a comet. A Frenchman, Jacques Babinet, then proposed a light wave in a vacuum as a natural unit of length independent of the earth's dimensions. Later the same thought was expressed by German, Dutch, and British scientists, but the first practical results must be credited to Americans, A. A. Michelson and E. W. Morley, who, in 1887, outlined "A method of making the wave length of sodium light the actual and practical standard of length." Their method, involving the use of the optical interferometer devised by them for their celebrated experiments on the relative motion of earth and ether, consisted of the measurement of a length and the counting of an equivalent number of interference fringes.

In 1889, Michelson and Morley described in detail a method of measuring the meter in light waves, and predicted that the brilliant mercury green line would in all probability be the wave to be used as the ultimate standard of length. Searching systematically for the radiation best suited as an ultimate standard, Michelson discovered in 1892, that the green light of mercury is complex, and discarded it in favor of the red light of cadmium. These classic investigations promptly led to Michelson's invitation to the International Bureau of Weights and Measures, where he performed his celebrated determination of the relation between the meter and the wave length of cadmium red radiation. In the succeeding forty years Michelson's experiment was repeated a half-dozen times and his result has been amply confirmed, considering the fact that the lines on the meter bar are ten to twelve wave lengths wide.

Indeed, it is the character of ruled lines themselves which limits the accuracy of wave length-meter intercomparisons and there is, therefore, hardly any point to measuring the wave lengths of Hg^{198} lines relative to the meter. The wave length of Hg^{198} green light can readily be measured relative to cadmium red light from ten to one hundred times more accurately than either relative to the meter. Adoption of the present provisional relation as exact, and subsequent substitution of Hg^{198} green for cadmium red appears to be the logical and expeditious approach to a better standard of length.

THE END.

THE ELECTRICAL ROBOT BRAIN

BY E. C. LOCKE

***Part II** of an article discussing an automatic course-computer for robot missiles—the M-9 Fire Director, a device that has all the essentials of an automatic spaceship navigation computer!*

We now know the mathematical problem the robot must solve. The next question is, what mechanism must we build into it to solve the equations? To answer this, two other questions must be answered; first, what is the precision required; and second, what are the mathematical operations to be performed? The question of precision logically comes first because conceivably the various mathematical operations could be handled in a number of ways. To be really useful the mean error of the computer should really not exceed, say, one tenth of one per cent. As a statistical proposition, this means that the individual components should be within, say, three one hundredths of one per cent of the design values! To mass-produce components of this accuracy is no mean feat under the best of conditions. It can become impossible if the components are too tricky.

The mathematical operations required are easily enumerated after looking over the problem. The most obvious ones are addition, subtraction, and multiplication. (It is curious that division does not occur although this can also be done quite easily.) The operation of differentiation is also needed for the calculation of target rates. Another necessary feature is the ability to store functions and to look up their values, not only for such simple functions as the sines and cosines of the angle, but also for the more complicated ones of two variables, such as the superrange and superaltitude data shown in Figure 4.

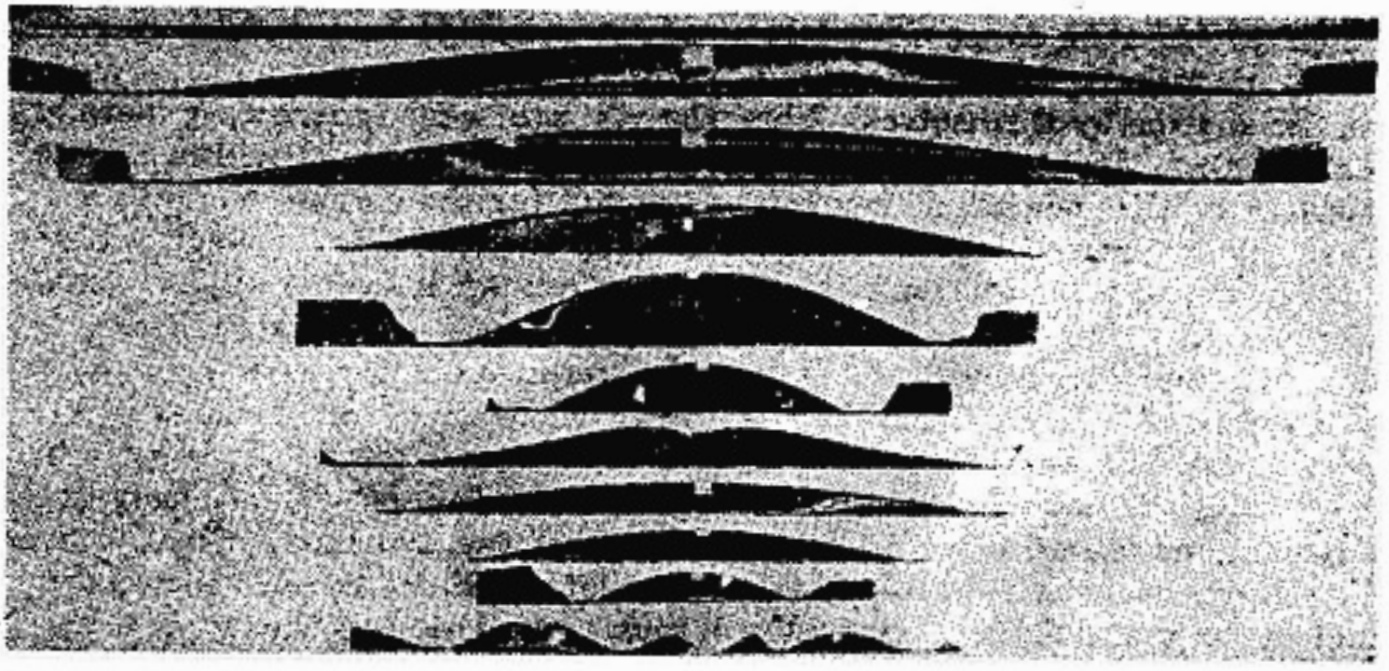
Let us not, however, overlook the most obvious and yet the most important process. This is the business of solving equations. It is not

enough to be able to perform the various operations, for these do not give the answer by themselves. The point is that the equations to be solved are the so-called implicit types. Hence something is needed to force the system to come to an answer.

Lastly, this forcing process must be continuous. This immediately dictates that the variables must be represented by quantities capable of continuous variation. One possibility is to use shaft position, another is to use voltages. Actually, both are used since this results in the simplest arrangement. This comes about because the primary data at the radar exist as shaft motions and the final answers are also wanted in the same form for easy transmission to the guns. Voltages are used in between because electrical circuits can perform the mathematical operations much more easily than the mechanical devices.

Getting down to brass tacks, what kind of voltage shall we use, AC or DC? Surprising as it may seem, it turns out that DC is the answer. The basic reason for this has to do with the fact that differentiation is a much easier process with DC than with AC. Why this should be so is not difficult to understand. Earlier we have mentioned the fact that the problem of the gun director was akin to the general communications problem. In any such problem the "intelligence" or data is transmitted by modulating a carrier of some sort with the data. This gives rise to the so-called sidebands which comprise the frequencies that actually contain the impressed information. In the gun director, these sidebands are very narrow, generally less than one cycle in width. If we use AC for the carrier, the differentiation requires very sharply selective circuits. It is difficult to build these circuits, in the first place, to the required initial precision. To have them stay put once they are built is even harder because of the effects of temperature variations and aging of the elements. Finally, the oscillator which supplies the carrier must be made to track very precisely with these tuned circuits. The combination of these factors made the problem of precise AC differentiation unmanageable. Fortunately, the other possibility, the use of zero frequency carrier, proved to be quite easy and accordingly DC was chosen even though this carried some other penalties.

One of these is the matter of amplifier drift. This cannot be eliminated but can be minimized by various dodges. One helpful trick is to use relatively high voltage levels for the signals. In the M-9, for instance, the signals may swing from — 140 volts to + 140 volts. By proper design the amplifier drift was brought down to a few millivolts, and thus the percentage error from this source was kept at a negligibly small value. A second way by which this drift situation was improved was by making the voltage sources very stable, to say a few millivolts out of about three hundred volts for a period of an hour or so. Such stability was undreamed of before the war, but then so were



Shaped potentiometers allow electrical circuits to yield sine, cosine, tangent, or logarithm functions directly as functions of angular or linear movement.

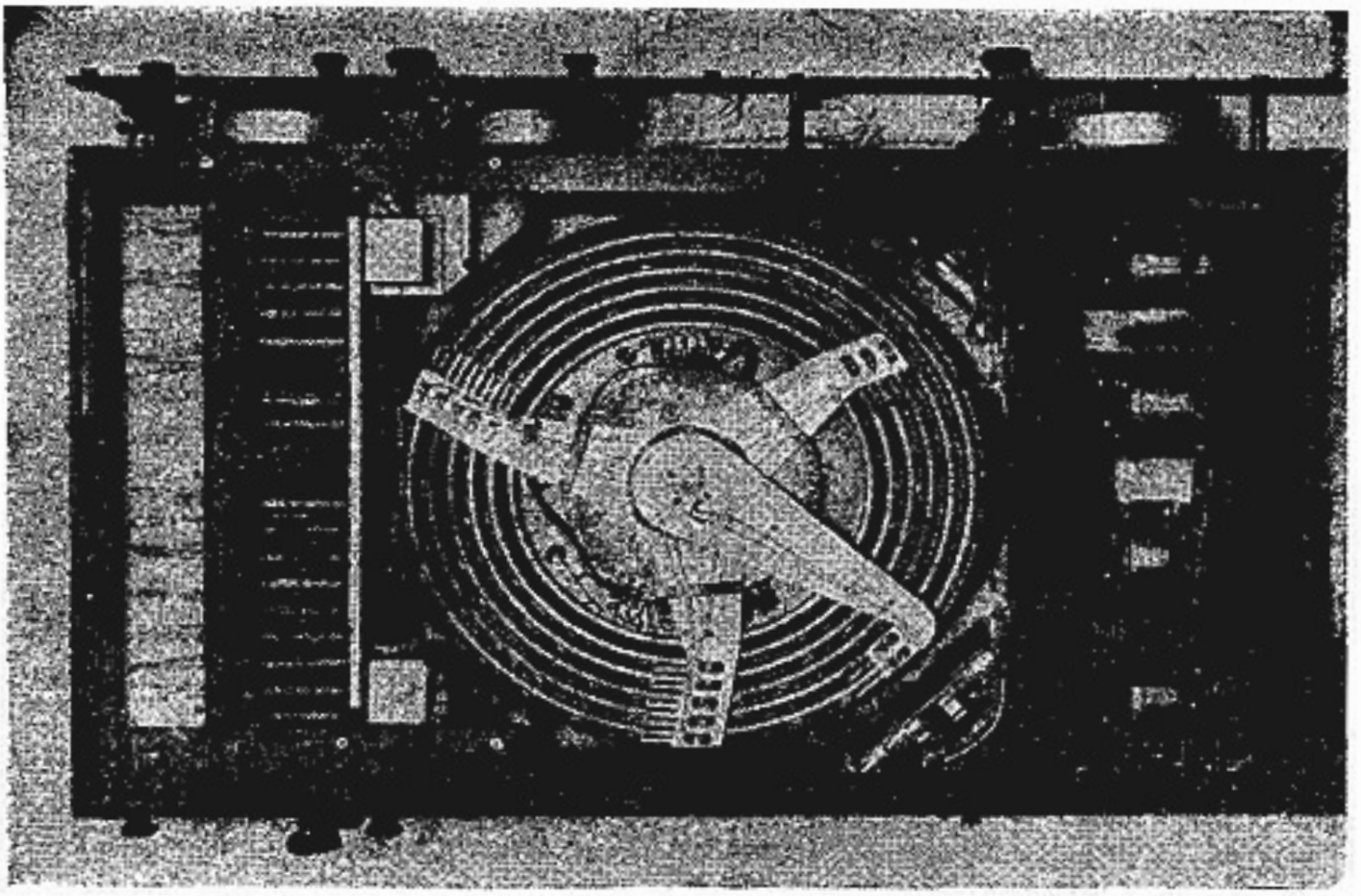
accuracies of three one hundreths of one per cent for mass-produced components

With these preliminaries out of the way, let us now see how voltages can be added with the required precision. Suppose we look at Figure 5 which shows the skeleton of a 3-stage DC amplifier with a voltage gain of about thirty thousand. The amplifier is so designed that when no signal voltage is applied to the first grid the plate current in the last stage is balanced out. Now apply the two voltages to be added, say E and e, to the grid through equal resistances R and tie the grid to the last plate through a resistance of the same value. It is obvious that to produce an output voltage V of, say, ninety volts across the lead, the voltage v required at the first grid amounts to only three millivolts. Hence, the currents flowing through the three resistors will not be sensibly influenced by this small grid voltage. Therefore, to a high degree of precision, the currents are respectively E/R, e/R, and V/R. But Kirchoff's well-known law states that the sum of all the currents flowing into a junction is zero. Let us, therefore, add up these currents and apply this law. We then get

$$V = -(E + e)$$

which shows that the output voltage is the negative sum of the input voltages. This scheme obviously works for more than two input voltages and, of course, they need not all have the same sign.

To the reader this result may look peculiar. He may well ask what has happened to the gain of



Underside of calculator unit of M-9 fire director, showing the multiple precision potentiometers that are the essential mechanism.

thirty thousand we talked about, and anyhow, why should one want an amplifier that does not amplify? The answer is that the internal gain is still there but the external gain was thrown away when we fed back most of the output. This, however, has bought us a great deal. For one thing, the amplifier is now highly linear within its overload limits. It is also very stable. If the gain of the tubes should somehow decrease by ninety per cent you would hardly notice it, for the feedback has ironed it out. Within quite broad limits the amplifier performance now depends only on the stability and precision of the external resistances and not on the tubes!

The amplifier also has remarkable voltage regulation. It is possible to hang several loads on the output with the voltage remaining substantially invariant. This comes about because the feedback has reduced the plate impedance from its normal value of, say, fifty thousand ohms to less than two ohms. Incidentally, another interesting result produced by the feedback is that the apparent impedance between the first grid and cathode has been reduced to about thirty ohms from its normal value of a megohm or so.

The amplifier is also very useful in isolating circuits from one another and for obtaining negative copies of the input signals. It should also be noted that by making the ratio of feedback and input resistances other than unity we can produce either a gain or a loss, which is another way of saying that we have an easy way of multiplying by a fixed constant.

These amplifiers are also used as precision differentiators. To see how this is done, look at the circuit of Figure 6. The triangle is meant as a shorthand symbol for the high gain amplifier previously described. The only other difference is that the input voltage is now applied through a condenser instead of a resistance. Using exactly the same arguments as above, the current through the condenser can be shown to be proportional to the time rate of change of the driving voltage. Since this current has to be exactly cancelled by the current through the feedback resistance, the load voltage is constrained to be proportional to the time derivative of the input. By the way, if the resistance and the condenser are interchanged, the gadget will integrate very nicely.

As a practical proposition the circuit of Figure 6 is not entirely satisfactory, because if a shot of noise gets in with the driving voltage a short pulse of extremely high amplitude will come through. This not only paralyzes the amplifier but will also give a terrific bat to the load. However, by putting a small resistance in series with a condenser this trouble can be eliminated although at the expense of a slight loss in precision.

Because of the small random fluctuations in the incoming data it is desirable to smooth out the output of the differentiator. This can be done by what is called a data smoother, a rather elaborate circuit involving resistances and condensers. This is quite a subject in its own right, but lack of space requires that we skip it here.

Let us now take a look at the problem of multiplying two variable factors. As mentioned before, we have shaft motions available. This suggests that we represent one of the variables by the angular displacement of the shaft of a circular potentiometer and the other by the voltage we apply to the potentiometer. To see how this works out, let us look at Figure 7. It shows a thin form or "card" of insulating material of — nearly — constant width, uniformly wound with fine resistance wire. One end is grounded and the variable factor, e, is applied at the other end. When the brush is at some angular distance from the grounded end, which is p per cent of the total angle subtended by the potentiometer, the voltage at the brush will clearly be p x e, which is just what is wanted. To do this with a precision of one part in three thousand or better would have been unheard of before the war. Prewar commercial potentiometers were good if they had an accuracy of one per cent. Yet, under the pressure of necessity the

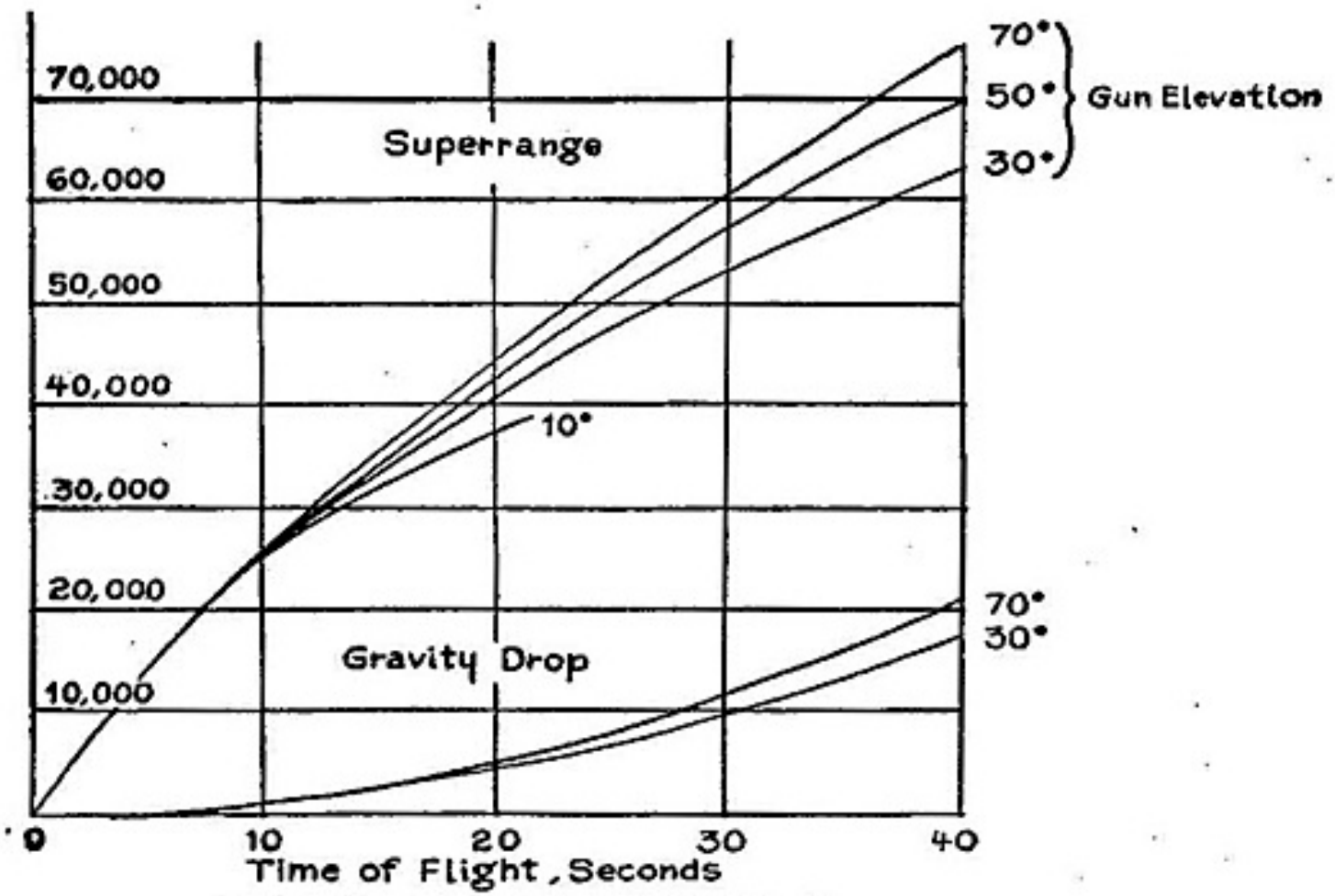


FIG. 4: BALLISTIC DATA

technique of winding and mounting potentiometers was so well developed that we can rely on the dial reading agreeing with the brush setting within one turn out of several thousand.

There is another point to note here which might escape the reader. The load draws current from the potentiometer and hence the result will not be precise unless we do something about it. This something is to make the width of the potentiometer slightly non-uniform as indicated in the developed view in Figure 8. This process is called "shaping." The amount of shaping depends on the ratio of the load resistance to the resistance we want in the potentiometer. It is not a very difficult matter to figure this out, but we cannot go into it here.

Let us see whether this idea of shaping the card can be further exploited. Suppose we give it a cosine shape, ground the center point and apply equal and opposite signals to the ninety degree points. What kind of voltage variation will the load get as the brush angular displacement, A, is varied? When the brush is at the center, the load gets no voltage. Now move it to the right in steps of one turn. The

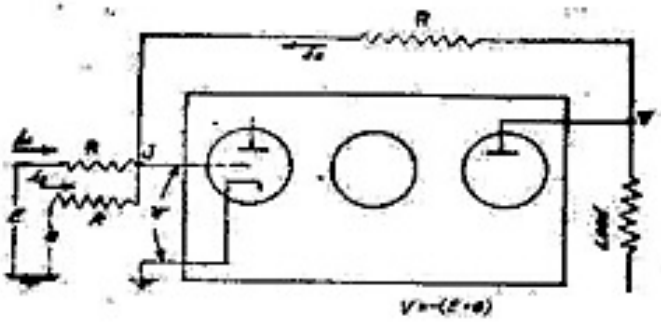


FIG. 5: FEEDBACK AMPLIFIER USED AS A VOLTAGE ADDER

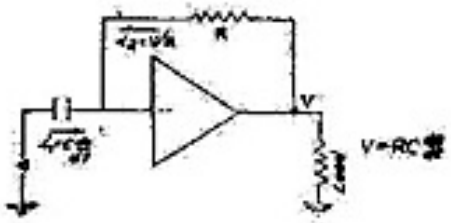


FIG. 6: FEEDBACK AMPLIFIER USED AS A DIFFERENTIATOR.

load voltage rises, but the farther we move the brush the slower is its rate of rise because the length of each succeeding turn of wire is getting shorter in accordance with the variation of the function cos A. Since the rate of rise is proportional to this function, it is clear that the load voltage will vary as sin A. If the experiment is repeated on the other side of the center tap, the load voltage variation will be found to be the negative copy of the first result.

This particular example may be pushed somewhat farther with profit. Suppose we adjoin to one end of the card shown in Figure 9, a second card identical with the first, and wrap the pair around a full circle as shown schematically in Figure 10. If we attach four insulated brushes to the shaft ninety degrees from one another, then one pair of brushes will give ± e sin A and the other pair will give ± e cos A. As the shaft rotates through a complete revolution, the signs of the brush voltages will vary precisely in the way trigonometry requires them to.

From this description of the means for getting trigonometric functions we can infer a broad principle. This is that we can duplicate any well-behaved function by making the width of the card proportional to the slope of the function, corrected, of course, for the effect of the load current.

What about functions like superrange and superaltitude shown in Figure 4? These are functions of two variables while the cases we have described were functions of a single variable. Since no one has yet figured out how to make three-dimensional potentiometers, somehow or other we must do the job with two-dimensional ones.

To see how this can be done think of the ordinary multiplication table that you memorized in grammar school, of which a sample is shown below.

TABLE I

Column	1	2	3	4	Row
1	1	2	3	4	
2	2	4	6	8	
3	3	6	9	12	
4	4	8	12	16	

This table has the property that any number in the table is the product of one number taken from the "Row" and another number taken from the "Column." This may be

painfully obvious, but its generalization is certainly not. What we propose to do is to take any table of numbers, such as a double entry table for superrange, and assume that the numbers in it were obtained by multiplying together a certain unknown row and a certain unknown column in exactly the same way as the above multiplication table was obtained. The real trick, of course, is to find this row and this column. The details of doing this would take us too far afield, but the reader is assured that it can be done.

Of course, no set of physical data is likely to be a perfect multiplication table, and the assumption may not lead to a very good fit. Fortunately, however, the generalization can be carried farther. Why not regard the data table as having been made up by superposing two or more tables, each of which can be assumed to be a perfect multiplication table? The answer is that this, too, can be done. The more such elementary tables we break up the data into, the better we can fit it.

Of course, the row and column for a given table or a sub-table are not identical as in the case of Table I. Thus, if we were to apply the process to, say, the superrange data, we would eventually obtain a set of two or more different factors which are functions of time of flight only, and associated with each, another factor which depends on gun elevation only. When these factors are multiplied together and the products are added, the numbers will be a very close approximation to the numbers in the data table we started with. The superaltitude function can be treated similarly.

If the data vary principally with time of flight and only moderately with gun elevation, we can chisel a little and set one of the elevation factors to unity. The reader will observe that the plots in Figure 5 act like this, and advantage can be taken of it in the design.

Without worrying about the actual shapes of the functions, it is clear that we now have the means at hand for generating functions like superrange which depend on two variables. Suppose that the data have been analyzed in the manner indicated and were found to break up into a time-of-flight factor f_1 plus the product of a second time-of-flight factor f_2 and an associated gun elevation factor g_2. These fac-

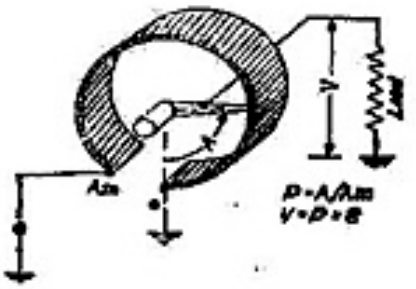


FIG 7 POTENTIOMETER USED AS A MULTIPLIER

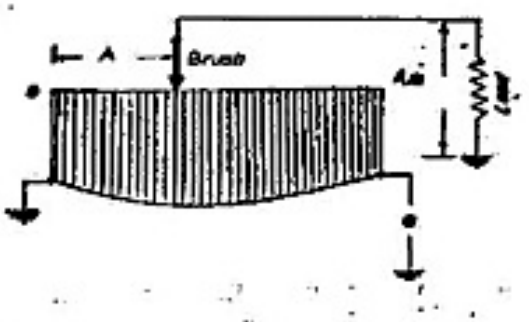


FIG 8 DEVELOPED VIEW OF LINEAR POTENTIOMETER SHAPED TO CORRECT FOR EFFECT OF LOAD CURRENT

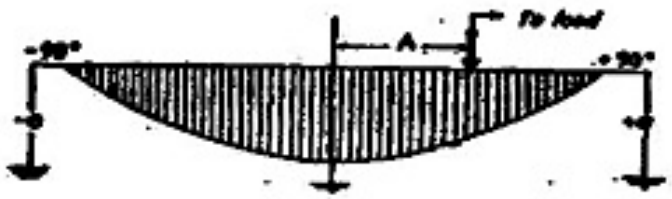


FIG. 9: POTENTIOMER SHAPED TO GIVE Sin A

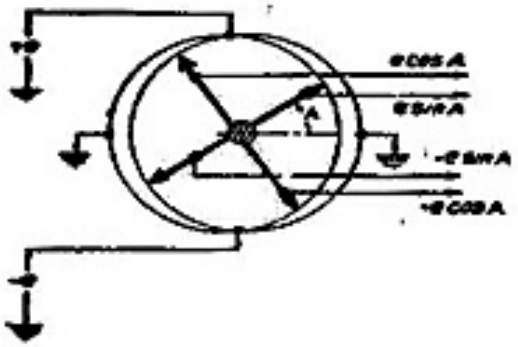


FIG. 10: FULL CIRCLE *Sine-Cosine* POTENTIOMETER

tors can be realized physically by taking a potentiometer as shown in Figure 11 and shaping it to give the f_1 function. This potentiometer is energized with a positive battery and its brush B_1 is connected to the amplifier input. Now we take a second potentiometer shaped for the f_2 function and use the voltage at its brush B_2 to feed the third potentiometer. This one is shaped to give the g_2 function. The output voltage from its brush B_3 is also fed to the same amplifier. If the brushes B_1 and B_2 are ganged together and set to the position called for by some specific value of time of flight, and if the brush B_3 is set independently to the gun elevation in question, the first potentiometer will give f_1, and the second pair will give the product $f_2 \times g_2$. The amplifier adds these up and reverses their sign. Hence its output will be the negative of the value of the superrange function for the specified values of time of flight and gun elevation.

Now that all the computing tools are at hand, let us see how equations can be solved. What is it that forces the solution of the implicit equations we have described? The answer is the servomechanism. Instead of giving a complicated and confusing definition, a typical illustration will make clear the workings of this gadget.

Suppose we wanted to build a device to answer the quite trivial question: What is the angle whose sine is any given decimal fraction? Stated in mathematical terms, we want to solve the implicit equation

$$y - \sin z = 0$$

for the value of z when y is given.

If a human computer were asked this same question, he would take a trigonometric table, enter it with some arbitrary angle and look up the sine of this angle. He would then note whether the value he just found was larger or smaller than the number y. Depending on which way it was, his eye would skip to either a smaller or a larger angle. He would continue to make such comparisons until he found the angle for which the sine was equal to the given number. The point to note is that in these preliminary trials the quantity $y - \sin z$ was not equal to zero, and the direction in which the human computer would look depends upon the size and sign of the error.

A machine of the type we have

been talking about would follow exactly the same procedure. In this device, we would represent the given number y, the "signal," by an appropriate positive voltage and the sine of the unknown angle by a negative voltage. This voltage will come from the sine table which in this case is a properly shaped potentiometer energized by a negative battery. If we let the brush position correspond to the angle z, the brush voltage will represent the—negative—sine of this angle. As the next step, we feed the brush and signal voltages to a summing amplifier as shown in Figure 12. As explained before, the output voltage V of this amplifier is the—negative—sum of the input voltages. It represents the error between the given number y and the sine of the first trial of the unknown angle z.

Now how are we going to reduce this error voltage to zero? Suppose we take a motor with the lightest armature that will handle the mechanical load involved and couple its shaft to the brush. Let this motor be driven by the output of a power amplifier whose input is this error voltage. If the motor is properly poled, it will run in the direction which will reduce the error voltage to very nearly zero. (It will not be exactly zero because of motor friction, but this error can be made very small indeed.) But this is the same thing as saying that the circuit has satisfied the equation and consequently the position of the brush shaft will be a measure of the unknown angle z. If now the signal y should be changed to a different value, the error voltage will suddenly increase and the process will be repeated. If the signal varies continuously with time, the brush position will likewise vary and continuously give the solution. The reader will note that there is a lag in this process which, however, can be made quite small by proper design.

We now see how a computer can be made to have the "inner urge" that will force it to seek a solution and why it is that the farther away the device is from the true answer the greater the urge to get the answer. In circuit terms all this means is that if the error is large the voltage applied to the motor will be large, and hence the motor will run very fast to get away from the incorrect answer.

Of course, no one would build such an elaborate device for such a trivial problem. The point to note is that exactly the same principles can be applied to the actual equations occurring in the M-9 Director. These differ from the example discussed only in being more complicated and hence will require more elaborate circuits. For instance, the signal may be comprised of the contributions of several circuits. More than one function table may have to be looked up, and each table may require more than one potentiometer to represent it as we have seen in the case of the superrange and superaltitude data.

THE THOUGHT PROCESS

Now that we know what constitutes the brain cells of our robot,

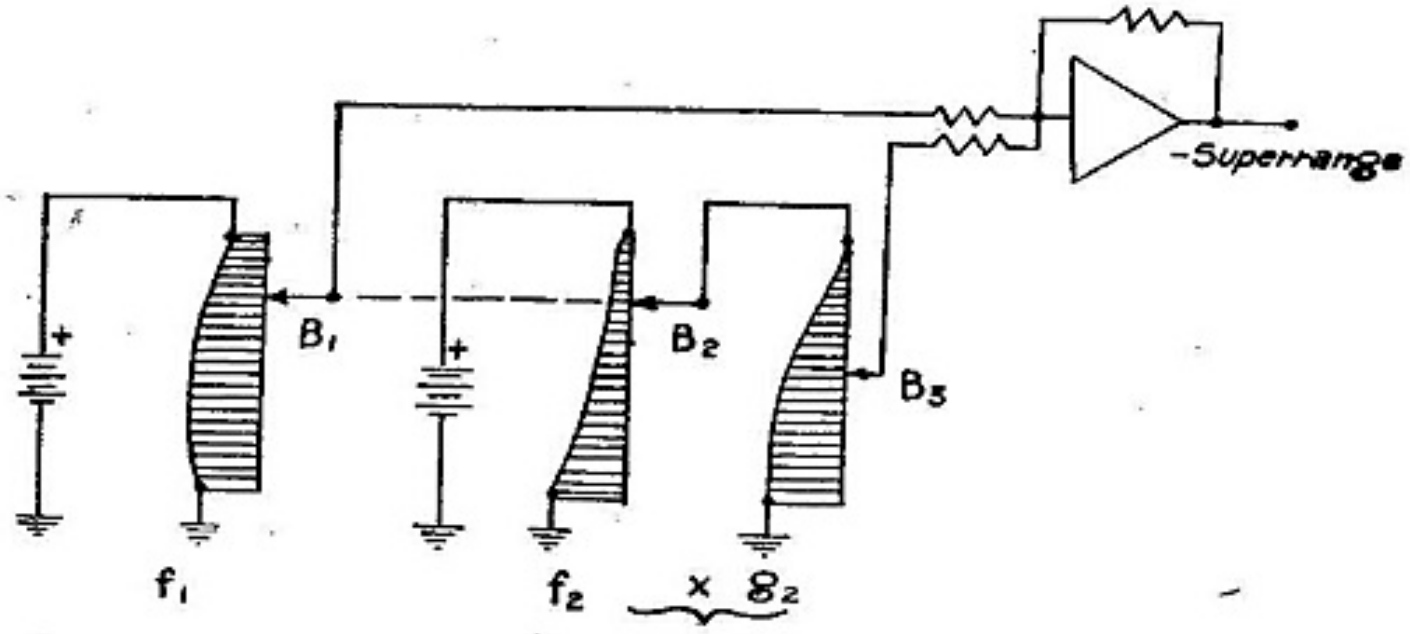


FIG. 11: CIRCUIT FOR GENERATING A FUNCTION OF TWO VARIABLES

let us see how these are integrated to do the thinking.

The pattern of connections between groups of brain cells is shown in the block diagram of Figure 13. This shows a number of boxes containing assorted circuits whose exact nature is of no consequence at the moment. All of the boxes receive electrical inputs, while some receive mechanical ones as well. The outputs of the boxes, however, are always electrical.

To see what goes on, we recall that the radar gives up polar co-ordinate data on the target's present position, and from this we wish to arrive at the values of the polar angles which will define the proper orientation of the gun. In between we wish to work with rectangular co-ordinates for convenience of design. Finally, we have seen that the key to the problem lies in the comparison of superrange computed by two different methods and the readjustment of the circuits until these values agree.

To this end, we provide in addition to the boxes containing the circuits, three servo motors whose function is the readjustment of the various circuits until the desired equality is obtained in the superrange computations. These motors are labeled A, E and T in the diagram and are used respectively in the gun azimuth, gun elevation, and time-of-flight circuits.

We are now ready to follow the flow of information in the computer. The "Co-ordinate Converter" box at the extreme left takes the shaft motions from the radar and converts their polar data into rectangular co-ordinates in voltage form. These in turn are operated on by the "Rate and Lead Com-

puter" to produce the "tentative" future co-ordinates of the target, again in the form of voltages.

The horizontal co-ordinate voltages now undergo a transformation under the action of the gun azimuth motor. Two things result from this manipulation; the gun azimuth motor shaft assumes a tentative setting, and a voltage representing the corresponding ground range is obtained.

Let us now skip to the box marked "Ballistic Tables." The circuits here are under the control of the gun elevation and time-of-flight motors. One of the outputs is a superaltitude voltage. This, together with the future altitude and the ground range voltage, goes through another conversion process. This results in a tentative setting of the gun elevation servo and an estimate of the corresponding superrange.

Having this estimate, we recall that a comparison value for this quantity is obtainable directly from the "Ballistic Tables" box. These two estimates go into a comparator and the difference is used to drive the time-of-flight motor, precisely as explained for the simple servo circuit of Figure 12.

As this motor turns in its attempt to eliminate the discrepancy between the two estimates of superrange, all the circuits undergo simultaneous changes. For convenience of description we may, however, consider them serially. In this sense then, the first thing that happens is that the target lead estimates are changed, thus changing the estimate on the future co-ordinates. This in turn alters the azimuth motor setting and the ground range. An altered value of superaltitude comes out of the "Ballistic Tables," which in combination with the altered ground range and fu-

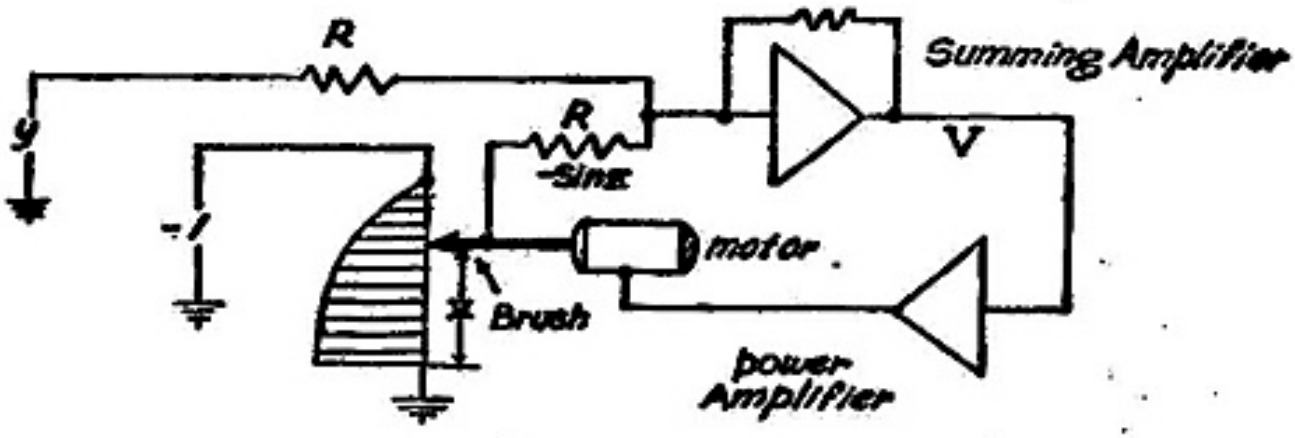


FIG. 12: SERVO-MOTOR CIRCUIT FOR SOLVING THE EQUATION $y - \sin z = 0$

ture altitude voltages results primarily in a new setting for the gun elevation servo motor. The estimated superrange coming out of this process is not changed radically. It is the other source of this quantity that is apt to be changed violently, at least at the start. Thus the process goes on, with the alterations in the values decreasing rapidly, until in a few seconds all circuits are in balance. The fact that while this readjustment is going on the radar data is changing is of relatively small importance. It is merely another source of variability to be taken care of automatically.

Now that we have seen the general pattern of operation of the computer, let us look into the contents of the boxes.

The first box receives a mechanical input from the slant distance shaft of the radar. On this shaft we mount a uniform potentiometer, which is energized by a battery. Then as this shaft rotates, the brush voltage will at all times be proportional to the slant distance that the radar has just measured.

Next, we apply this voltage to a 180 degree sinecosine potentiometer mounted on the horizontal or elevation shaft of the radar antenna. There are two brushes on the potentiometer ninety degrees apart. The "sine brush" will then deliver a voltage proportional to the present altitude and the "cosine brush" will yield the present horizontal range.

As the last step, we put a three hundred sixty degree sine-cosine potentiometer on the vertical or azimuth shaft of the antenna. This we feed with the horizontal range voltage and again use two brushes at right angles to break this down into the co-ordinate distances X and Y. Now we have the present position data in the desired form.

These co-ordinate voltages now go into the "Rate and Lead Computer." It will be sufficient to trace through only one of the co-ordinates, say X, because the circuits for the other two are identical. The first thing to do is to put X through a differentiator and a data smoother, to get the target rate along the X direction. This is applied to a uniform potentiometer whose brush is driven by the time-of-flight servo. The brush voltage is the product of the X rate and the time of flight. Physically, this is the lead predicted along the X axis. Now, by adding this to the original X voltage we get the future or predicted X co-ordinate of the target. In exactly the same way the predicted Y and Z co-ordinates are obtained in a pair of identical circuits.

At this point, the block diagram calls for the determination of the gun azimuth angle. From the geometry of Figure 2, it can be worked out that the tangent of this angle is X/Y, the co-ordinates being, of course, the predicted values. However, it is more convenient to solve this in the form

$$X \cos A - Y \sin A = 0.$$

This will be recognized to be a slightly more complicated version of the implicit equation we have previously used to illustrate the work-

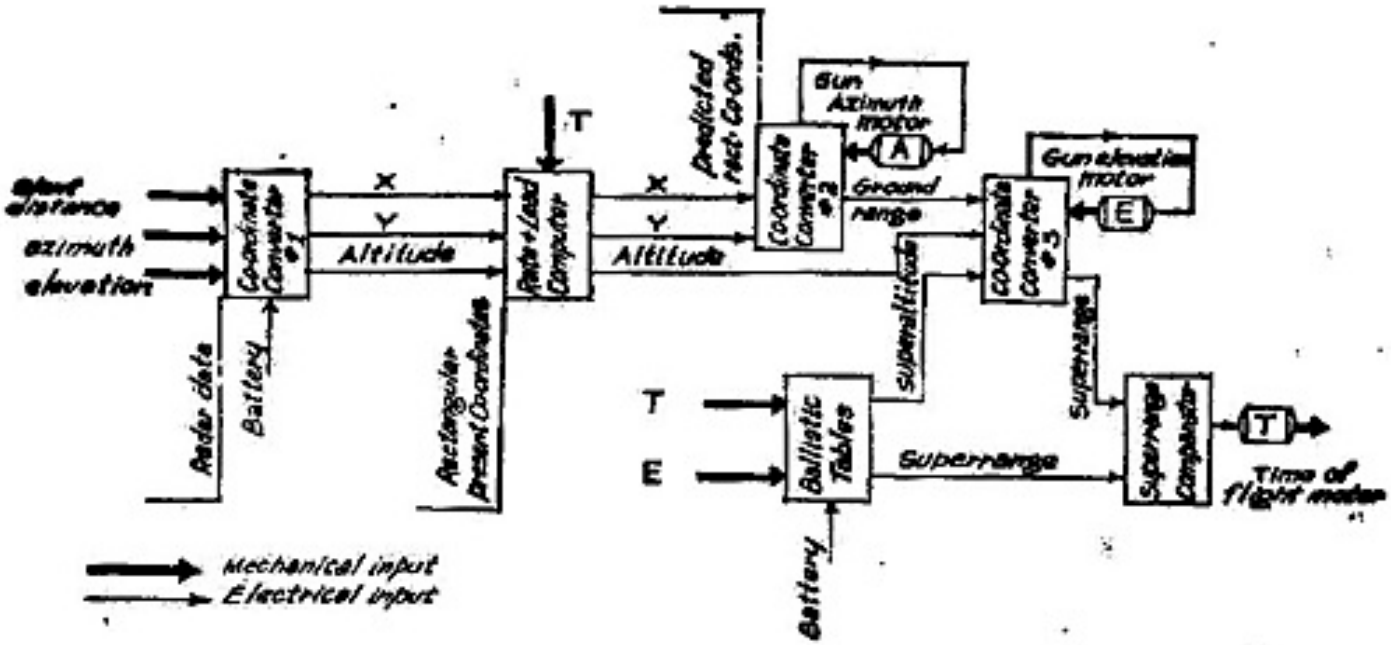


FIG.13 : BLOCK DIAGRAM OF DIRECTOR

ings of the servo. To solve it, we mount a pair of sine-cosine potentiometers on the shaft of the A motor. One is energized by the X voltage and the other by the Y voltage. A cosine brush on the former and a sine brush on the latter will generate the separate terms. Their difference is then used to drive the motor to equilibrium in exactly the manner described before.

It turns out that if we put a second brush on each potentiometer, ninety degrees away from the first, and add their voltage, we get out ground range as a voltage.

The gun elevation motor setting is obtained by applying precisely the same principles. The two voltages that are used are ground range and the sum of the altitude and superaltitude voltages. The superrange voltage is obtained in a manner entirely similar to the way the ground range voltage was obtained previously. How the second estimate to this voltage is obtained can be seen from inspection of Figure 11.

The actual transmission of the solution to the gun is easily accomplished. All that has to be done is to put transmitter selsyns on the gun azimuth and gun elevation servo shafts and corresponding receiver selsyns at the gun. The receiver selsyns follow the motion of the transmitters, but they cannot deliver any power. The necessary power to move the gun is applied by other servos at the gun which follow up on the receiver selsyns. These are powerful brutes which can swing the heavy gun weighing many tons about as easily as a man can swing a walking stick. It is these servos that keep the gun pointed to the correct spot continuously.

Before the advent of the proximity fuse, it was necessary to trans-

mit another piece of information to the gun, namely the fuse number of the shell. The fuse used was a mechanical one, and it essentially consisted of a small clock on which the "alarm" could be set off after a predetermined number of seconds. That is to say, if the computer solution came out that the time of flight to the target was to be thirty seconds, this information was supplied to the fuse setter. This then set the little clock so that the shell would explode thirty seconds from the time it left the gun.

This business of setting fuses was quite a headache. First of all, since no one has yet figured out how to set the fuse after the shell has been loaded into the gun, it had to be done before it was loaded. Now the physical act of transporting the shell from the fuse setter to the gun might take four seconds. This meant that an extra prediction had to be made by the computer which ranged ahead of the main prediction by this four seconds, expressively called dead time. This would not have been so bad except for the fact that with most antiaircraft guns the shell is transported from the fuse setter to the gun manually. Since human beings never perform exactly the same under repeated trials, particularly during long and exhausting engagements, the dead time of gun crew would vary by appreciable fractions of a second from round to round. Thus there was a strong likelihood that the shell would burst either too soon or too late. Even a variation of only one tenth of a second might be enough to cause a miss because in this time a four hundred m.p.h. target would travel twenty yards which is somewhat more than the lethal radius of the shell. The advent of the proximity fuse has put an end to all this trouble. For this reason it did not seem worth while to go into the rather elaborate matter of fuse calculation. It is interesting to note that the remarkable score made against the V-1 bombs was obtained with proximity fuses.

Another mater of importance that we can touch on only briefly is the matter of the ballistic corrections. The muzzle velocity of the gun does not stay constant; it varies with the temperature of the propellant and also decreases slowly with the number of rounds fired. The variations in the density of the air also exert large influences on the trajectory of the shell. Then there is the lateral drift of the shell, caused by its spin, and the effect of the wind. These ballistic effects are large, and each of them can amount to hundreds of yards. Their inclusion in a practical director is, of course, of paramount importance.

The material we have covered gives only the barest outlines of the principles, structure and operation of the director. The fields of knowledge which were drawn on to bring this director into existence were many and varied. In turn, it may be confidently expected that the techniques developed will find important applications in industrial process control and in new types of computing devices.

Editor's Note:

No machine yet devised is capable of true thought—though a definition of that term would be exceedingly difficult. Calculating machines of immense complexity, however, have been built. Yet most of the more illustrious calculators—Eniac, M.I.T. differential analyzer, the Harvard-Navy-IBM digital calculator—are simply multiple repetitions of relatively simple individual units. The ordinary office machine calculator is, essentially, a mechanical way of counting on your fingers—save that by using gear teeth instead of fingers, you get more "fingers" in less space, and can count them faster. The Digital Calculator at Harvard is a super-super finger-counter. Just a gadget with more fingers that can count faster.

The M-9 fire director was an unusual sort of calculator in many ways. Unlike most calculating machines, it picked up its own data, fed that data into itself continuously, figured out the answers, and did something about the answer when it had it—it pointed the guns at the target. It was strictly a military robot; at its height, in full application, it was the master robot of a large team. The principle members of the team were a sensory robot, the M-9 executive robot—which considered the reports from the radar sensory robot, reached conclusions, and ordered appropriate action—and the gun itself which was its long, strong, and deadly right arm. The most numerous type of robot in the whole team, though, were the little suicide robots that rode the noses of the anti-aircraft shells, the little proximity fuse robots.

This deadly team did its most telling, its most important work against a very stupid, but also very dangerous enemy robot. The M-9 robot team was advanced as far beyond the almost brainless V-1's as a cat is beyond a wasp.

But of more general, more long-term interest, is this discussion of how mathematical data can be fed into a machine calculator, and how that mathematical data can be handled electromechanically. Complex data tables can be built into the machine as memorized material which the circuits can consult as needed—tables of sines and cosines, tables representing the change in explosive power of a given type of propellant with changes of temperature and humidity.

Each of these devices is a basic concept, applied in this instance to a specific task. But the principle is general; instead of calculating how to make a suicidal robot follow a collision course to an interfering body, the M-9 could, as readily, be redesigned to calculate non-collision courses for spaceships in meteor-infested volumes of space.

This, gentlemen, is—in full working detail—an inverted description of a radar-sensing, automatically reacting meteor avoider!

THE END.





WAR OF INTANGIBLES

BY ERIK FENNEL

***One** of those strangely delicate, strangely deadly situations where the co-operation of two bitterly hostile enemies is essential to the success of the plan of each—and each fully knows it!*

Illustrated by Orban

The helicar's wheels touched and automatic brakes hushed the whirring rotors. The girl stretched her slim body as she climbed out, flexing her muscles, for all during the three hour flight from War Center she had leaned forward in her seat as though cramped posture could hurry the machine through the air.

A year before the trip would have been a matter of microseconds, but the NRT unit in the vehicle had been dismantled and confiscated in compliance with the Proserv's decree. Teleportation within the great invisible warp-shield protecting the hemisphere had been strictly forbidden ever since the Eurasian Combine's first attack.

The house was a lightless blacker blotch in the sweltering midsummer night, but a line of brilliance showed beneath the door of the barnlike laboratory nearby. Above the chirp of crickets she could hear music, the brooding bass viol theme from

Tchaikovsky's "Swan Lake." That meant Pen and his—friend—were still at work despite the late hour.

The girl kept to the grass beside the gravel path, walking quietly. She was ill at ease, more than half ashamed of the doubts and suspicions that had impelled her to make the trip, but a sense of duty lent her determination.

Without warning she stepped into a supersonic barrier. Pen had changed the alarm system since her last visit weeks before and the pins-and-needles effects of the soundless vibration locked her muscles in painful partial paralysis. In the laboratory a gong clanged. The music broke off in the middle of a note, the light beneath the door winked out, and seconds later a spotlight found her face.

"Oh, it's you!" Pen's voice was unsteady, irritated yet alarmed.

The light shifted to her helicar, and with it no longer in her eyes she could see Pen in the doorway, a heavy blast pistol ready in his hand.

"Sorry you walked into that, Doris," he said coldly as he cut off the vibration barrier, "but I've told you to call me first."

"So you could tell me not to come?" She was still astonished at her own lack of personal pride and restraint in following a man to his home, a man who had told her he was through. But it had been a compulsive urge.

He did not answer and they watched each other in strained silence.

"It's hot out here," Doris said at length.

Pen shrugged ungraciously and motioned her to enter, closing the door and switching on the glaring overhead lights.

The—whatever it was—filled the center of the big room. The shining ovoid hull resembled a spaceship in miniature, except that the rocket nozzles were disproportionately small. Whatever work was in progress was being conducted inside, hidden from her stare, and the parts and supplies stacked nearby were unrecognizable. She gazed at it in uneasy dread, realizing it was stupid to hate a machine. But this—thing—held the key to Pen's conduct. It—and the other man.

Harold Kalkan laid aside his murderous flame rifle slowly, as though with regret.

"So. The propaganda peddler again." His voice was heavy and guttural, fitting his huge fleshy body.

Pen made a jerky gesture for him to be quiet.

"Well?" he asked impatiently.

"Alone, please," the girl said tightly, repelled by the way Kalkan's beady eyes roamed over her filmy blouse and brief skirt. It was not desire. A butcher might look at cattle that way.

Pen inclined his head toward his cubbyhole office. Doris followed him, slamming the door behind herself harder than necessary.

He slumped into one of the two chairs while she remained standing, watching him apprehensively. Stubble covered a face that had grown gaunt and deeply lined in recent weeks, and he was badly in need of

a haircut. His eyes were bloodshot and a tiny muscle in his right eyelid twitched spasmodically. He needed three attempts to bring his lighter and cigarette tip together.

For a moment tender concern overcame even her angry sense of betrayal. She laid one hand on his shoulder.

"Arthur Pendragon Tilford," she scolded, "you're killing yourself. You can't stand much more."

His face tightened and hardened. "Won't have to," he said.

That startled her. It made no sense. Her eyes widened as she waited for other symptoms of incipient breakdown to show themselves. Subconscious synthesis was a nerve-wracking process, and she had suspected for a long time that Pen was once again engaging in it. But he only sat there, sunk once more in a glum lethargy of fatigue.

"I don't suppose it's any use asking you again to come to War Center?" she inquired.

He sighed wearily. "We've been over all that before."

"And about tomorrow night. You said—" she persisted.

"That's off." He shook his head slowly. "All off. No time."

The nervous anger born of strain too long continued, the flickering anger that was becoming so common throughout the Hemisphere as the war dragged along, sparked within her and her lips parted in the beginnings of a bitter remark.

But Kalkan's booming voice penetrated the closed door. "Arthur, can you come here a minute?"

"Pretty quick," Pen answered, his arms pushing against the chair to help him up.

Then suddenly the anger was gone and there were tears in Doris' gray eyes. She buried her face on his shoulder and after an almost unnoticeable hesitation he held her close in the way that had once been so delightfully familiar.

"Oh, Pen!" she sobbed. "What's happened to us?"

His lips were close to her ear. "Get out!" he hissed. "For God's sake get out and don't come back!"

Then he pushed her away, speaking harshly aloud as he took her arm and hurried her toward the door.

"Our interlude was a mistake, as I've told you before. You'd better go now."

As she climbed into her helicar she turned and looked back at him, frustrated and disturbed. She had learned nothing, and nothing had been settled.

"Pen?"

"Yeah."

"Come on down anyway if you change your mind. You need the Blue Ray."

Without waiting for an answer she started the rotors.

Pen's fists clenched. He hated himself for causing the unhappiness so plain on her face, and her taunt about the Blue Ray had hurt.

Overhead and to the south a rocket flamed into sparks as the disgrid caught it high in the stratosphere. They still fired occasional projectiles, probing for flaws in the material defenses, just as they were

still testing teleported weapons against the warp-shield in hopes of breaking the deadly balance.

Pen winced and closed the door.

"Let's get to work, Harold," he said. "Time grows short."

Pen laid down his tools and his face assumed the masklike fixity of transition. Then he stood up, his movements awkward and discoordinated with fatigue.

Kalkan raised bushy eyebrows.

"Brain-fag," Pen explained. "Too many irrelevancies sneaking in."

"Yes," Kalkan agreed reluctantly. "We can not afford to chance a subconscious dissociation now. Any progress?"

"Like your Delta," Pen responded laconically. "Coming, but slowly. The McKetrick equations, I'm sure they fit in."

Pen watched him narrowly for a a reaction, the tic in his right eyelid making him look as though he were sharing some huge joke. But his mood was far from jovial. He knew his reactions were becoming erratic from exhaustion just when the period of greatest danger was approaching.

"But they're complex stuff," he continued. "McKetrick went really deep before his brain blew up. No more tonight."

At the house they ate a silent meal in the dusty kitchen, using all-in-one food packets that were quickly prepared. Kalkan ate quickly, methodically. He finished first, threw the empty plates into the disposer while Pen lighted a cigarette, and sat down again.

"Tilford." He leaned forward. "That girl becomes a problem."

Pen straightened in his chair. He had gone half asleep sitting up. "Who? Doris?"

Kalkan's smile was mirthless. "A woman who finds herself no longer wanted is the most deadly creature on Earth."

"Huh?"

"Besides, she has come to believe her own propaganda. At any time she may report us to the Proserv. Then we would die with all the others in the coming collapse, if not sooner."

"Doris wouldn't do anything like that."

"No?" There was a sneer in Kalkan's voice. "Don't blind yourself. She less than half believes your story that our work is not on the forbidden list, and she hates me. You want to live, don't you?"

Pen's face showed something that looked like craven fear.

"What would you suggest?" he asked quickly. "But remember she's important enough to be missed."

"That appointment for tomorrow evening."

Pen's eyes squinted.

"I couldn't help overhearing," Kalkan apologized hastily. "I would go to War Center, shower attentions upon her, make love to her if that is what she wants, help her believe. That should give us another week or two, time enough.

"Besides, an evening of relaxation would allow the McKetrick equations to settle themselves better in your own subconscious. You

would be assuring our escape in two ways."

Pen considered all facets of the complex situation. He hoped it would not do too much harm at this stage to allow Kalkan to prowl the laboratory alone. And it was a temptation.

"I think you've got something there," he agreed.

The pattern had had its beginnings in the chaos that followed the inconclusive Atomic War thirty years before. The first disruptor-grids had put an end to the effectiveness of rocket-driven missiles, atomic and otherwise, and ended the war in a deadlock which came too late to stop widespread destruction. And so the Eurasian Combine had come into being amid radiation-blasted ruins, a warped politico-technological autarchy pandering to the desperate hunger of the survivors for some form of order, cemented into unity by envy of the Western Hemisphere which had escaped more lightly.

The outlines of the pattern had emerged with the invention of the psycho-compeller, the story of which was still a mystery. But the power-craving autarchs of the Combine had gained control of it and used it with maximum effectiveness. Purely human civilization on two continents had ended the day the psycho-compeller mechanism was installed in the domes of Inner Citadel, replaced by a termitelike social organization in which the individual was no longer a free agent. The separate particles of the Eurasion entity had not objected to their lowering living standards. They had gloried in it—as they were psycho-compelled to do—because that meant greater military power.

For a long time, while the Eurasian Combine prepared for the conflict its leaders considered inevitable, the rest of the world had not even dreamed of the existence of a device which could control the mind and will. Visitors to Eurasian territory were psycho-compelled without realizing it to see only what the leaders wished them to, and to report everything serene and prosperous. The leaders allowed only enough criticism to sidetrack suspicion.

When Pen Tilford had been little more than a child a well-known newsman had returned from a trip to Eurasia with sensational reports. He had been injured the year before in an explosion aboard one of the experimental moon rockets, had undergone extensive brain surgery and carried a large tantalum plate in his skull, and so his disclosures and accusations were discounted as products of mental injury. Shortly after his first articles appeared he had died in a fire which burned his home to the ground. The meaning of these events had not become apparent until years later.

The next factor to shape the pattern had been the discovery of subconscious synthesis, more fundamental than any mechanical invention. Subconscious synthesis was an entirely new method of thinking, utilizing the ninety-odd per cent of the brain that ordinarily lay idle or

at least uncontrolled. But it was not for everyone. It had as prerequisites certain subtle and indefinable qualities of mind and a high stage of autohypnotic training. And it was dangerous, extremely dangerous. It originated in the Hemisphere, and was not kept secret.

One of the first triumphs of the method was to correlate the theoretical work on subtronics, postulated materions, space warp and the variable helix of time, entropy shifts, the reversible transformation of matter into broad or unavailable energy, concepts that had been merely the intellectual playthings of mathematicians, and translate them into practical shape.

Teleportation had been the result, in the form to become known as NRT, no-receiver teleportation. Receiver and transmitter were a single unit, and the instrument itself as well as matter within its field could be teleported to any preselected destination and reconstituted there. It was received by the public with an utter lack of understanding and unlimited enthusiasm, making obsolete all other forms of transportation within a year or two.

But it had not been without cost to its discoverers. Both men who had taken part in its subconscious development had died puling idiots without being able to explain or reduce to writing the complex theories behind it. That was a fate only too common among the pioneers of subconscious synthesis.

Military minds had been quick to grasp the possibilities of teleporting atomic bombs and similar examples of frightfulness into the midst of enemy territory, into places that could not be reached by rocket-powered weapons on account of defensive disruptor grids. So while the world was hastily revising its habits of living a feverish race for counterweapons went on in secret.

The Eurasian Combine, as soon as its leaders thought themselves immune from retaliation, had been the first to unleash teleported warfare. But they had been too late. Without understanding them fully the Hemisphere scientists, too, had learned to modify NRT principles to produce a warp-shield, and except for the initial strike the Eurasians' teleported attacks had been shunted into some unguessable limbo. But defense had been possible only by abandoning all teleportation within the warp-shield, and the shield covered both continents of the Hemisphere. The dis-grids completed the isolation, making it impossible to enter or leave the area by any normal means of transportation.

And so the military technicians of the Hemisphere and Eurasian Combine had filled in the details of a pattern of almost-stalemate that had endured for an interminable, intolerable year. Whichever side could first learn to penetrate an antiteleport shield could destroy the other at will.

Hemisphere casualties had been limited to mental breakdowns of technicians from overwork and ordinary citizens from strain and worry, and the execution of the few Comps a vigilant Proserv had detected. Weapon matched counterweapon

with perfect precision and the stalemate would have been complete—except for the deadly phycho-compeller which was the heart and soul of the Eurasian Combine.

Eurasian leaders did not share the morale problems that plagued the Hemisphere. Their people were robots, supremely confident of victory, unable to worry, selflessly devoted to the Eurasian cause.

Although the psycho-compeller was not universally effective at the extreme range between continents, with terrifying frequency some hitherto trusted Hemisphere citizen went *Comp* under its influence and became a creature of the Eurasian staff, a traitor. It was subtle and unpredictable in its action, and its intangible shadow lay heavy and malignant across the Hemisphere. A single Comp in the right place might sabotage the tenuous balance of forces in the shield, breach the entire defense.

All attempts to duplicate or neutralize the psycho-compeller had resulted only in the mental collapse of many of the Hemisphere's subconscious synthesis adepts.

During the flight Pen tried to keep his mind clear of the McKetrick equations. Conscious thought about their possible applications could only set up undesirable negative conditioning. The trip bored him, took time he could ill afford. He wished he could set the NRT controls and arrive over War Center in split millionths of a second. Or perhaps if the variables were exactly right a fraction of a microsecond *earlier than he had departed.* He started to consider the significance of those occasional arrivals ahead of departure, but deliberately forced his mind away from that subject also.

The clustered lights of War Center appeared ahead, huddling beneath the towering black cloud-pile of a summer thundersquall. Pen's lips twitched with distaste. A city again.

Teleportation had finished the process of decentralization that atomic power had started. When the time interval between traveling a single mile and ten thousand could be detected only by the most elaborate instruments there was no longer any need for men to crowd together in cities. Men had found a new freedom, a more spacious mode of life.

War Center was a reversion born of necessity, and the very unsubstantiality of its architecture proclaimed that it was intended only as a temporary expedient. With teleportation impossible under the warp-shield it was necessary that all the selected brains responsible for prosecution of the war be concentrated within easy reach of each other. And so War Center had been hurriedly thrown together.

Pen oriented himself by the projecting multiple antennae of Vizaudio Central, from which all propagandized news and entertainment went out to the entire Hemisphere, and lowered his helicar deftly to the roof of a nearby residence building.

Doris was still at work, but when he held his identity disk against the

contacts on her door the latch clicked. That meant she had expected him after all, or at least hoped. She was a persistent woman.

He could not help noticing the individualizing changes she had made in the standard quarters assigned her. Curtains at the polarizing windows. Ornaments. A couple of good pictures. Reading lamps and a shelf of books. The homelike atmosphere depressed him, for he knew he could have no part in it.

He turned off the overhead lights, mixed himself a drink, selected a music reel. Then he settled himself in an easy-chair and tried to relax his wire-taut nerves as he waited. But his mind refused to remain blank. A subtle trace of sandalwood perfume in the air triggered a stream of almost unbearably poignant memories.

. . . the days when Doris had produced her vizaudio shows for entertainment instead of the official propaganda line . . . their first meeting . . . she had known almost from the start that he was an S-S adept, but she had understood . . . and despite the widespread notion that adepts were peculiar and unstable she had trusted him . . . the too-short days of their trial marriage and those few wonderful weeks together on that small and still primitive island near Samoa . . . the sense of irreparable loss that had overwhelmed him as they listened to the vizaphone announcement of war . . . the white, shocked look on her face when he told her that it was all over between them, that it was no good and he was through . . . the hardest thing he had ever done, and Doris had made it still harder by refusing to accept his words at face value . . . but he had known what was necessary.

Finally he dozed.

The click of the latch brought him to his feet, his hand moving instinctively to his armpit for the blast pistol he had left behind.

"Pen! You came!" Doris cried, and put her arms around him.

For a moment she clung, then pushed herself away.

He grasped her shoulders. "Why are you looking at me like that?" he demanded.

She buried her face in her hands and shuddered.

"They caught a Comp in Vizaudio Central today. Right in my department, a man I've talked with often and even eaten lunch with. And all the time he'd been making unnoticeable little changes that altered the whole psychological reaction, promoting neuroticism and disunity, undoing all our work. The Proserv liquidated him right there. Oh Pen, it was horrible!"

He mixed an extra strong drink and handed it to her. "Try not to think of it," he advised.

She gulped it straight down, and after a few minutes recovered control of herself.

"I know all about the microtimer and special equipment you had on your helicar's NRT unit," she reminded him, returning to the subject she had brought up so many, many times. "And one night you told me some of your theories."

Tension started building within him again. She guessed too much.

"I was just talking that night. Mostly nonsense," he broke in quickly.

"No you weren't," she contradicted. "You had ideas that right now might mean—the difference. Darling, we need you here in War Center. You *can't* be a slacker, not with your brains and S-S ability. Unless—" She left that thought unfinished.

There was no such thing as conscription. It was a war of technicians and advanced technologies, and all that was expected of the mass of the population was that they remain calm, follow their ordinary pursuits in so far as possible, and avoid hysterical demonstrations. War Center technicians were all volunteers, the pick of the Hemisphere's brains.

Doris was almost crying again. Pen's eyelid began to twitch.

"You need the Blue Ray," he declared coldly. "You're developing a psychosis."

Her eyes blazed scornfully. Then she sighed. "Let's not quarrel tonight."

She left the bedroom door open as she went to change. He heard the shower start, and then a few minutes later she called something to him about fixing himself another drink. He looked up automatically as she passed the doorway, her tanned, unclothed body unhurrying and unashamed. She was deliberately using the ancient feminine weapon that had remained effective from the stone age to the teleportation era, but he knew instinctively that it was not for personal reasons alone. Doris was too honest to play it that way.

It was a lure, and even through the haze of fatigue that had become chronic he could feel the old desire for her rising again. But he would not allow himself to respond.

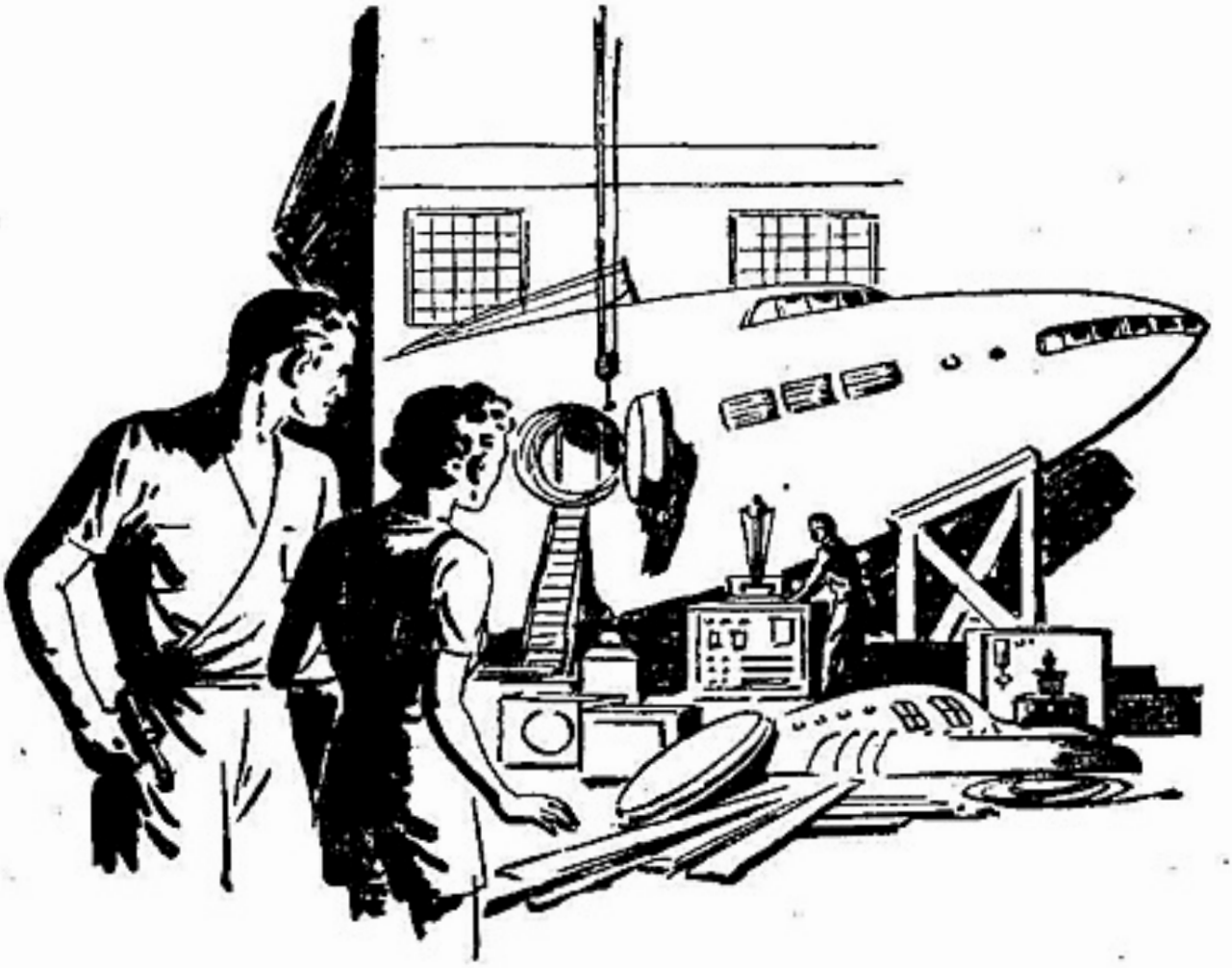
She dressed quickly and pirouetted so he could inspect her brief costume of shorts, halter and woven metal sandals. Her ring-curling auburn hair was casually arranged, for she had learned long ago that overelaboration only annoyed Pen without impressing him. Still the feminine weapon, but more subtly now.

He held up a thumb and forefinger circled in the old signal of approval, and she smiled.

"Let's try to forget everything and just have fun tonight," she said.

They ate dinner under an air-conditioned plastic dome atop one of the higher buildings, and for a while it was almost like the old days. Almost. Then they wandered hand in hand through the steaming, humid streets, stopping occasionally in bars as much for the relief of indoor coolness as for the drinks. He noticed how War Center had grown during recent months, but still it was overcrowded and incomplete, uncomfortable with a frantic sense of hurry and impermanence.

At Doris' suggestion they visited a night club. Couples were swaying in the soft light that came up through a translucent floor and the music was strongly rhythmical and satisfying, although somewhat loud



to cut through the hum of determinedly gay conversation. The place was much too crowded for Pen's tastes.

He raised his eyebrows. "Total war effort?" he asked cynically.

Doris turned on him fiercely. "Without these the neurotic index would triple in a week."

Pen eyed her sharply, disturbed by her sudden vehemence.

" . . . I didn't mean to break over like that," she said shakily. "Come on, let's dance."

For an hour she was a gay and apparently carefree companion, and if he had not known her so intimately he would never have guessed the gallant effort it required. She was doing her best, but the deep pity and sense of guilt she aroused in him made him regret his weakness in coming to see her again. It would have been better—. Doris was a well enough integrated personality to endure the suspense of the deadly war situation without cracking. It was her emotional involvement with him that produced the overstrain.

And then all at once she began to cry, tried to stop herself, failed. No one so much as looked up as Pen paid the bill and escorted her outside. War Center had become accustomed to such outbursts.

At the door of the Blue Ray station down the street she grasped his hand.

"Won't you—?" she pleaded.

Impossible. When repressions had more than a personal survival value—

"I'll meet you here," he declined.

He picked up his helicar from the roof, landed in the empty street and sat there smoking thoughtfully. He jumped, startled, as the man in the uniform of the minor Proserv tapped on the cabin window.

"You can't park here," the Proserv declared with a frown.

"She ought to be out any minute now," Pen argued, watching the doorway across the officer's shoulder.

The Proserv's sternness relaxed. "Oh. Like that. My wife cracked wide open too, just the other morning. Great stuff, this Blue Ray, but how I wish the whole mess would end one way or another! Anything would be better than this waiting!"

"It is hell," Pen agreed fervently.

Doris came out with a sleepy, half-smile on her face and snuggled close beside him.

"Hope your wife makes out all right," Pen called as he started the blades.

"Same about yours," the Proserv answered.

Doris giggled. "I'm a shameless hussy," she whispered to Pen.

They flew aimlessly out over the surrounding countryside while gradually the first lethargy of the Blue Ray wore off.

After a while she straightened on the seat.

"That Harold Kalkan," she said suddenly, shivering as though with a chill. "He's not what he's supposed to be. And he hates you, Pen. I can feel it."

Woman's intuition, Pen thought angrily, could be dangerous.

"He's a good technician in his field and I need his knowledge," he snapped.

"For what?" Her question slashed like a whip.

"That's none of your business," he retorted roughly.

Her next words could never have passed her lips without the inhibition-relaxing effects of the Blue Ray.

"Last night I *knew* . . . that one of you . . . was a Comp!"

Pen blinked. He reached forward to adjust the throttle, shaking her hand from his arm. He didn't want her feeling the change in his pulse.

Then he lied to her slowly and thoughtfully and thoroughly. Finally she settled back again and he hoped she was really convinced. But he had doubts. She knew him too well.

Doris had failed to warn him that the drinks they had had all contained the new relaxing synthetics in addition to ethyl alcohol. That mixing had become standard practice amid the tensions of War Center, with official approval. Now Pen began to feel that his laboratory was in another world and for the first time in months he was completely at ease. And so tired.

Doris cushioned his head on her shoulder and reset the autocontrols. Only when she switched to manual operation for the landing did he stir and yawn.

"Come on down, Pen," she invited softly.

He followed her docilely.

"No sense of you flying back tonight," she said as she closed the door.

The sun was a high purple disk through the polarizing windows. Doris had dressed and gone to work without awakening him, despite his sleepy mumble that he had to get back to his laboratory.

He was filled with a sense of loss as he looked around for what must be the last time at the clothes she had worn, all the little personal possessions that were such intimate reminders of her.

He started to leave, paused to scan the note fastened to the doorknob.

"Go right back and fix yourself some breakfast before you leave," she had written in her neat, clear hand. "And come down again soon."

But he knew he would not return.

She had helped him immeasurably without knowing it. Without this interval he had been unwilling to snatch for himself he would most certainly have botched the final synthesis on the prediction-analyzer, that last vital link. Now he had to hurry, but he wished with all his soul that he could stay. Pen had no martyr complex.

"Well?" Kalkan demanded.

"She won't bother us any more," Pen declared with a confidence he did not feel.

Kalkan grunted. "You should never have let her come here in the first place."

Pen smiled thinly. "Ever try to stop a redheaded woman?"

Kalkan muttered under his breath, and Pen pretended to miss his words about the spoiled women of the Hemisphere. The time was not ripe.

"How's the Delta coming?" he asked.

The tight, colorless lips that looked so out of place on Kalkan's heavy jowled face quirked. "Finished," he said. "Completely, entirely. How soon will you have done with the prediction-analyzer?"

"Perhaps tonight, with any luck. Let's get to work."

Kalkan held back.

"Tilford, do you not think we should each put our completed formulae in writing, in case something should happen to one of us. In that way the other would still have a chance."

Pen shook his head. Someone was getting overanxious.

"That's impossible. You know an S-S job won't reduce to symbols, and besides it's not finished."

Kalkan nodded, his lips tight with exasperation. But he was not through with questions.

"Connected to the analyzer—as much as you have finished—is something I do not completely understand. It is similar to the main NRT transmuter, but with capacitors of improper balance, and it will produce an unfamiliar wave form. A cross between a sine curve and a sawtooth—what one might call a bulge-sided sawtooth—with periodic

varations of amplitude. Subtronic, of course. Its field of influence, I should judge, would fall not within the hull but ahead of it. How does it function? Can you explain?"

Pen thought fast, wishing he dared lie. He was unwilling to release another shred of information, particularly about that. He had taken too many risks already, with lives that were not his with which to gamble. But the other member of their strange partnership was not a fool. And besides— Somewhere in the picture would be a subconscious synthesis adept, more probably a co-ordinated staff of them. And already they had the McKetrick basics. He had to stick to facts —but withhold a few.

"Oh, the materionic corrector," he said. "If you split a high-energy meson—say of above 3×10^{16} electron volts—in the brief period before spontaneous degeneration into an electron of like sign and a pair of neutrinos takes place—you get a startling effect. Part of the energy seems to disappear without being replaced by an equivalent of additional mass. That is an anomaly, according to the accepted $E = mc^2$ basic, unless you take into account the existence of bound or unavailable energy, and materinos of zero mass and neutral charge.

"That is the basis for NRT, a transformation of a portion of actual matter—a portion small enough to be represented by the fraction $\frac{1}{\text{infinity}}$—into *potential* matter in the form of bound or unavailable energy associated with materions. But this fraction has been an uncontrolled variable rather than a constant, which accounts for arrivals, or reconstitutions, higher in the time scale than their accompanying departures.

"Space warp and the time helix are interdependent, and both are influenced by planetary mass. That's elementary radiation theory, and when properly applied explains why no off-planet NRT has ever been successful, why the moon ships and exploratory expeditions to Mars and Venus before the war had to use reaction drivers, rockets. The distortion is a variable, uncontrollable until now by man because its origins are on a cosmic scale.

"A warp-shield is in effect a device for shunting bound energy to a different position" in time-space curvature, so matter teleported into a shield arrives at some destination quite different from the intended one, missing in space or time or size-reference or perhaps dimensionally.

"So the materionic corrector is part of the necessary counterfactor, just as the prediction-analyzer is. To penetrate the hemisphere shield without destroying it and displacing ourselves, we must be ahead of ourselves not only across the time helix but across space as well, *being potentially in an infinite number of places and times at once*, by Earth's reference frame.

"Of course as you increase the fraction of matter present in potential form only, you increase the hazards. Leakage in reconstituting might cause disastrous bodily and

mechano-structural omissions at the end of teleport. And if the energy-equivalent of even a few molecules should revert from bound to available state you would have pure atomic destruction. Not merely fission of the nucleus but complete energy liberation, with God knows what results.

"That's where your Delta field-stasis work enters the picture. During the transitions to and from the state in which we will be approaching a hundred per cent matter in its potential, bound-energy-plus-materion phase, the Delta will have to hold the localized time field. Otherwise it would be—the end."

Kalkan's face was wrinkled in a frown, and Pen did not blame him at all.

"Of course words will not carry the concept with any accuracy. Too much lost in semantic vagueness. But when we're no longer working against time for our very lives, when we don't have to worry about imminent destruction, I'll give you the basics and you can run the subconscious synthesis yourself. It'll be a long job but you'll find it interesting, although the concept itself is absurdly simple when you once hit the track.

"And I'd like to give your Delta development an S-S going over, too, when we have a chance."

"Certainly. Naturally. Of course," Kalkan agreed too quickly and far too heartily.

Pen wondered when Kalkan—and those behind him—would make their move and what form it would take. One man, and a desperately tired man at that, against—how many?

A couple of hours later Pen was prepared for the final session. Everything he might need, tools and supplies, had been assembled at hand, for it was vital that results be interpreted into concrete form without an intermediate stage of paperwork. Letters and numbers were a conscious-mind creation far too inflexible to record subconscious concepts.

That was the chief drawback of the subconscious method, the impossibility of reducing its findings to writing or two-dimensional diagrams. Some day, Pen confidently expected, a new "language" would evolve in which the subtly complex information could be transmitted from one individual to another without complete repetition of its development. But he was deeply grateful that that day had not yet arrived, that subconscious synthesis was still largely a matter of individualism.

He entered the egg-shaped hull through the round port in the side of the nose, edged through the cramped control section, and squeezed through a narrow hatch into the windowless compartment which occupied most of the space. The ship was stripped to essentials.

The tic in his eyelid had begun all over again and his palms were sweaty. He wiped them on his coveralls and tried to force his mind into blankness. But that was difficult when the slightest misjudgment now would result in disaster—and not to himself alone. Kalkan was

no fool . . . it must go so far and no further . . . his wrist watch was ticking too loudly . . . the others . . . the McKetrick equations meant . . . if Kalkan suspected that he suspected . . . the rising wind was whistling around the eaves of the laboratory . . . no use.

"Harold," he called through the open hatch. "Put a reel on the machine."

"What do you want?"

"Anything. But turn it up loud."

The crashing, thundering chords of "*Götterdämmerung*," that prophetic musical saga of the collapse of an era, filled the laboratory. Pen's mouth twisted in a wry smile. There was something appropriate about the music Kalkan had selected. Somebody was going to get it, but good . . . if only he dared . . . now . . . but . . . only Kalkan had data for the Delta . . . data for the Delta . . . not through synthesis . . . must be co-ordination . . . materionic corrector . . . humbug . . . if he guessed . . . Doris . . . Kalkan was dangerous, even if . . . if only Doris could know . . . so at least she would not hate his memory . . . if she were alive . . . if any were. . . .

Pen stared fixedly at the worklight on the end of its cable. His pupils contracted to pinpoints. Then, abnormally, they dilated again. For several minutes he sat absolutely motionless, and when he moved at last his hands no longer trembled. His mind had shifted to the overrunning subconscious drive and his manual dexterity was supernormal. Almost as fast as a Comp's enormously speeded reflexes.

The sweltering heat had broken in a night storm and rain was drumming on the metal roof, but Pen was only dimly aware of it as he staggered from the hull of the escape machine. Kalkan helped him to a cot.

"Complete?" he asked eagerly, his pale eyes avid.

"Water." Pen croaked, giving himself time to think.

"Nothing left but co-ordination," he said at last. "Your part and mine. We can handle that together without S-S. Then we'll see."

He wanted the idea of incompleteness fixed firmly in Kalkan's mind --and those behind him—for upon it depended his temporary safety. After this last and most mind-wracking session he needed a rest before the showdown.

"One hour, Harold," he said. "Wake me then."

Kalkan shook him at exactly the appointed minute. Pen bathed his face in cold water and surreptitiously gave his system the powerful and unaccustomed shock of a stimulator pill. He was well aware of the price he must pay, of the depressive kickback sure to follow, but anything could happen now. Kalkan—or the others--might grow overanxious. He must be ready. And it was worse than futile to make fixed plans. Such preconceptions would only hinder his mental flexibility.

Together they began connecting the separate units of the complex mechanism to form an integrated whole, the knowledge of each supplementing that of the other but each unable to explain completely

even if he had wanted to. Pen gave the exterior of Kalkan's field-stasis Delta only a cursory glance, knowing he could never understand it without tedious and painstaking S-S study for which there was no time.

Together they placed the last unit. The compact welding head winked once more. Pen shut it off and raised his dark goggles with a gesture of finality.

"Well?" Kalkan broke the silence.

"That's it. Now to calibrate."

"No tests?"

Pen looked pained. "Inside the shield? We built this thing to escape, not commit suicide. The first time power goes on it'll be make or break."

Kalkan looked doubtful but unready to argue the point.

Their side-by-side position as they walked toward the meter cabinet was not as accidental as it appeared. Soon, very soon now, one of them must act.

The alarm bell clanged stridently, its harsh vibrations seeming to penetrate every fiber of Pen's body and shake him into a shocked alertness surpassing anything before. Kalkan, too, was not the nerveless robot he had appeared. A large meter slipped through his hands with a tinkle of shattering glass as he whirled. With surprising speed for one of his bulk he snatched up his flame rifle and raced toward the door, muttering a foreign-sounding oath Pen had never heard before. Kalkan—or someone—had slipped again. Was it anxiety or overconfidence? Pen wondered in that small corner of his brain that remained apart and detached.

"Tilford!" Kalkan growled, his voice gutteral with rage. "It's that meddling woman again!" He raised his weapon to the peephole beside the door and leered across the sights.

"No!" Pen yelled. "Don't shoot!"

Kalkan's face was twisted with disgust as he turned, and he still held his rifle ready.

"What matter? We can be gone before the Proserves arrive."

Pen thought quickly and pointed to the wrecked meter.

"No duplicate here. Want to go out with an uncontrolled beta factor?"

Kalkan scowled. "Then send her away."

"Pen!" Doris' voice came thinly through the wall.

"Go away!" Pen yelled. "Go on home!"

"I won't! You let me in or else—!"

Pen looked meaningly at his angry companion.

"If she comes in, she stays," Kalkan declared.

"Until we leave," Pen assented.

"By force if necessary."

Pen knew that Kalkan would do his utmost to see that she did not leave alive. More than strategy was involved. There was in addition one of those inexplicable but potent hates that sometimes spring up between two individuals as though by instinct. But there were things more important even than Doris.

Kalkan sneered openly as Pen unlatched the door.

A burst of wind-driven rain swept in with the girl. Her clothes clung revealingly to her skin and water dripped from the black plastic case in her hand. A double frown-wrinkle crossed her forehead and her lips were compressed. There was no warmth in her eyes, only aversion and lurking fear, and in her movements a desperate resolve contesting with nervous near-hysteria.

"What brought you out in this storm?" Pen asked, his voice sounding unnatural even to himself.

"This." The girl set down the box she carried and with a decisive movement raised the lid.

Pen whistled. "Where'd you get it?" he demanded, instantly on guard. He recognized it as a testing device recently developed by Proserv technicians.

She ignored his question.

Pen laughed mirthlessly, filling in the silence. "Me? A Comp? Don't be stupid, Doris."

Tears gathered in her eyes. "I've got to *know*, Pen. Can't you understand how I hate all this?"

"What are you going to do?" he asked uneasily. Her presence made the situation more unpredictably explosive than ever, and the sight of her had done something to him, disturbed his single-minded concentration.

Once he had thought the entire matter through calmly, even coldly, and had reached an inescapable decision. But now he was confused by her nearness and the danger in which she had placed herself.

But Kalkan must still be made to believe that his only motivation was a fear-driven desire to escape death.

"Put it on," she said, holding out the headpiece of the brain-wave tester. "If you're not a Comp, I'll go away and never bother you again."

Then she turned and stared at Pen's companion, and her purpose showed in her expression. Concern for her lover had made her underestimate Harold Kalkan.

Pen saw the change in the big man's stance. He dropped the headpiece and lunged across the few intervening feet just as Kalkan's rifle came up. His outflung arm struck the stubby barrel and the sizzling blue bolt shricked a hole high in the wall. Kalkan gave a hoarse cry of pure rage and tried for another shot as Pen struggled with him.

"Run, Doris!" Pen shouted. She had precipitated the showdown and there could be no more sham.

But instead of racing for the door she fumbled a compact explosive pellet gun from a wet pocket and stood indecisively in the middle of the floor. Her tiny weapon was half raised and her intentions were obvious, but she had no chance to fire without hitting Pen, too. Kalkan saw to that.

She was still standing there when the lock and handle of the outer door disappeared in a shower of sparks.

The Proserv who appeared in the doorway did not call for surrender or pause to investigate; in total warfare such scruples led only to defeat.

He raised his gun, but Kalkan was faster, tearing away from Pen and unleashing a flame bolt. A gaping, blackened hole appeared in the Proserv's chest and with a last convulsive movement he squeezed his trigger. His shop spattered in a searing flash against the resistant alloy hull of the machine beside Pen.

Through the needles of flame that danced before his eyes Pen saw Doris struggling in Kalkan's heavy arms. And he glimpsed another Proserv who threw himself down in the doorway behind the body of his dead companion.

Kalkan fired again, holding Doris as a shield, and although the body of the dead man absorbed most of the blast the second Proserv screamed in agony, his clothing charred and his skin blistered. Kalkan backed toward the ship, his beady eyes flicking from side to side on watch for more enemies.

Pen knew that this was no chance encounter. Doris must have called in the security force in response to what she considered her higher loyalties, and he did not blame her or hold it against her even though he saw nothing but death ahead—death without victory, all his work useless.

But perhaps it could be without defeat either. The Proserves might kill Kalkan, too. And Doris would—

Pen staggered toward the port, knowing Kalkan *must not* reach the control panel alone. Better that all be destroyed.

Kalkan released Doris just long enough to swing a stunning blow to her head, and as she slumped he scrambled through the circular port.

For an instant the opening was



obscured in white scintillations as a Proserv's flame shell exploded on its rim, but Pen dived blindly head-first in pursuit, knocking Kalkan aside just as he started to swing the heavy door shut. Something struck his head, but even as he slipped into unconsciousness he heard a scrambling noise and two voices raised in anger. A thud. A popping sound. Then—

The door latches clicked and the power packs gave their deep-throated hum.

A Proserv slashed his way through one wall of the laboratory with a cutting torch and raised the powerful rocket projector that could breach even the hull of a space-ship. Then slowly he lowered it.

The big room was empty. The target had vanished. Teleported.

The Proserv stood in stricken motionlessness, expecting at any instant the deadly Eurasian attack that would mean the warp-shield had collapsed.

Pen groaned and tried to rub his burning eyes. But there was resistance. With quickening heartbeat he discovered that his hands were held behind his back by something thin and sharp and unyielding that bit into his wrists. Wire. Painfully he struggled to a sitting position. His ankles were wired, too.

The taking of prisoners was not an Eurasian custom, but as his brain cleared he guessed with a sinking shock why he was still alive. Even disassembling the prediction-analyzer without full understanding of its principles would not be enough to reproduce it, and he, Pen Tilford, was the only living person who held answers.

Somewhere in the darkness the analyzer clucked like a roosting hen disturbed at night, correcting for a major distortion, then went silent. That told him he had been unconscious an unbelievably short time—or that there had been difficulty in the warp-shield and Earth's own time-helix displacement. And that he was in the power compartment.

Concussion filled the air with shrill protests of straining metal and Pen was tossed helplessly about, unable to protect himself from the bruising, gouging corners of machinery. And then his breath was knocked out as a body caromed into his chest in the darkness. Instinctively he swung his bound hands as best he could to grapple for a throat, and for an instant hope replaced black despair. If he could kill Kalkan before—

But the body was too small, too soft.

The ship pitched to another tremendous concussion and Doris was whirled away before he could decide if she were dead or unconscious. He remembered the scrambling sounds, the voices. It must be Doris. So Kalkan was—

Then all other sounds were drowned in the shrill whistle of the subtronic capacitors building up a teleport charge. He forced his scorched eyelids apart—and saw. The plates and heavy tubular leads of the Delta glowed momentarily a lambent green, as they should.

He sighed with relief that the Proserv's blast had not blinded him permanently, but as the same time that detached portion of his mind tittered ironically. What matter now whether he were blind or not? Kalkan held the winning hand.

The ship whipped into teleportation with half charged capacitors as Kalkan hit the discharge button in panicky haste. The outlines of the glowing plates blurred and even the darkness itself seemed to writhe sickeningly. There was no sensation of time, whether instants or ages, no reference frame for judging time.

The writhing ended and Pen found himself plastered against the floor as though he weighed a ton, barely able to wriggle. The ship bucked and twisted, completely out of control in the grip of tremendous gravitational or pseudogravitational forces.

The capacitors whistled, and once more there was a period of writhing emptiness. The oppressive weight diminished, disappeared.

With rematerialization a surge of radiant energy crashed through the heavily insulated hull. Pen gasped for breath in the stifling furnace atmosphere and felt his skin prickle strangely. Mixed-wave radiation. The power packs sputtered ominously as a bombardment of subatomic particles brought them dangerously near the effective critical mass that meant chain fission and explosion. Pen discovered he felt no fear. He was almost ready to welcome the flash and shock that would end everything. At least it would end Kalkan, too.

But once again the capacitors sang, and when the wracking strain vanished this time the ship hung quietly. The heat was gone. Pen had a chance to think, to wonder where they had been, what had happened to them, and where they were now. But he found his brain working slowly and vaguely, rejecting the wild surmises that flashed like a series of disconnected pictures.

They had gone out uncontrolled in Kalkan's hurry to evade the heavy weapons of the Proserv, without destination settings. Now they were —somewhere. Pen wondered if the psycho-compeller were capable of reaching across time and space and dimensions to — here — wherever here was.

His shoulder muscles bulged as he strained to free himself. Blood oozed stickily around his hands as the wire bit through skin and flesh, but that was all. It did not even loosen. He rolled over, tried to saw it against a projecting corner, and gave that too up as useless. From the feel of the wire, the peculiar way it grated against the steel corner, he recognized it as frewite alloy of high tensile strength and almost unbelievable abrasive resistance. There had been a coil left over from the final work on the intercontrol.

Inside Pen's head something slipped, and for a full minute he struggled and squirmed in a frantic, terror-ridden and utterly undirected effort to break free. Too much subconscious synthesis at too fre-

quent intervals had left his brain oversensitized and vulnerable, and claustrophobia, the blind panic of a trapped animal, moved in and took possession so that for a while he was scarcely human. But at last his body exhausted itself and he subsided into shamed quiescence. Gradually there was a return of rational thought, and with it came fatalism.

There was one more hope, a million-to-one chance. But it could at least foil—*them*. Doris also would die—if she were not already dead—which was sad but unavoidable. They would at least be dead together.

Entirely by sense of touch he inched along until he encountered the upright cylinder of a power convertor. He felt its warmth and the slight vibration of its whirling internal parts as he locked his knees around it.

Then slowly, holding his breath, he leaned backward with outstretched fingertips feeling for the bare copper bars that curved up five inches apart. He touched one, and from memory knew where the other would be.

He pressed his wrists tightly together so the oozing blood would form some electrical contact between them, and then with an effort of will plunged his metal-bound hands between the conductors.

The wires vanished in a burst of fire and vaporizing metal. Crimson agony burned through his arms and wrenched at his chest. But it was over in a split second as the galvanic effect threw him clear.

When his head cleared and he was able to move, the remaining shreds of wire fell away. He sat up, alive, and began to claw at his ankle bindings although each movement sent knives of pain through his burned, tortured hands.

Blue-white, blinding light flooded the power compartment as the hatch opened. Instinctively Pen turned his eyes away from the glare. A stray beam fell on Doris, huddled and inert in a corner, her long bare legs somehow pitiful in the way her dress, still wet from the rainstorm, was twisted high around them. Pen thought he saw her chest move slightly, but he could not be sure and did not dare investigate.

"Tilford?" Kalkan croaked from the hatchway.

"Yeah?" Pen said dully, shielding his eyes.

"We're — lost! We're — n-nowhere!" Kalkan was openly frightened. "And the controls are damaged. She did it."

Pen blinked, using Kalkan's hesitation to finish untying his ankles but puzzled by the big man's attitude. But if they were really lost—

"She shot at me," Kalkan explained. "Shock knocked me dizzy. Then she tied you up before I recovered. Then I took care of her."

It sounded plausible. Kalkan must have been very busy at the controls, too busy to tie him up. Doris could have killed him, probably should have, but women had moments of irrational softness. Men, too. He glanced at her motionless body.

"Dead?" he asked as though it were a matter of minor importance.

Kalkan shrugged, a noncommittal gesture, and it took the full measure of Pen's self-control to keep from leaping at his throat.

The window ports of the control room were full of glaring brilliance, and outside was an expanse of luminous, blinding *nothingness* without visible source. There was something completely alien to human experience, something terror-inspiring, about the light. It hurt not only the eyes but the brain too, submerging Pen's normal scientific curiosity in a passionate desire *not* to know the nature of this alienness.

Deliberately Pen ignored the outside and turned to the control board. Instrument glasses were shattered and in one place the plastic panel itself had been ripped, disclosing the carefully calculated maze of wiring and tubing beneath. It looked like the result of an explosive pellet from a gun such as Doris had carried.

Kalkan waited anxiously for Pen's verdict. His eyes strayed to the Delta field-stasis section of the board, but with a startling lack of understanding. Pen kept him waiting longer than necessary while he studied the damage.

"The intercontrol and automatic field stabilizer are clear gone," he announced at last. "Beyond repair."

Kalkan made a rasping sound in his throat. "But we can get back? To our own world? I did not mean to bring us to—this. Or those other —places."

There was something different about Kalkan's movements, the way he held his powerful body, even about the way he spoke, something hesitant and unsure, and slower. Pen guessed the answer to one of his unuttered questions about the psycho-compeller. It would not reach into this—place.

He frowned as he studied the cluster of instruments transferred from his helicar, the special recording instruments that had first put him on the track of this concept. They had been designed only for use within the Earth's normal field, without the artificial distortion of the warp-shield. And they definitely had not been intended for extra-terrestrial or interdimensional use. There had been no time to develop a suitable set. But he hoped their tracings in reverse might provide a track, blazed trees in a cosmic forest. Otherwise—

"Did you use the materionic corrector at all?" he asked.

"Yes," Kalkan admitted. "When the other controls failed to remove us from that great burning ball I pressed the corrector stud in desperation."

Pen wondered in what time and what unworldly dimension that solar mass now was. It must have been a solar mass in whose intense radiation field they had materialized.

He watched Kalkan's face, almost refusing to believe that the man had been blind—and still was —to the full significance of the single adjusting handle and activating button of what he had called the materionic corrector. But the

fleshy face showed only worry and fear, without a trace of understanding. Pen could imagine the turmoil in the big man's mind. He was unaccustomed to being left entirely on his own and had missed the obvious clues.

Quickly, before his scrutiny was noticed, Pen turned back to the recording instruments.

"It's too complex for straight calculations. We'll have to use S-S to figure power settings. You run it, too, and we'll compare results."

He could not resist making that jibe. Kalkan's eyes widened and he opened his mouth to protest.

"It's our only chance. I'll stay in here and bring the girl in with me. I'm used to her brain-wave pattern, so she won't interfere, if she's still alive."

Pen hoped this would go over, although it was stretching the concepts of subconscious synthesis rather thin. If what he had guessed about Harold Kalkan were wrong—

"But it would be easier—" Kalkan remonstrated with callous brutality, and Pen felt sudden relief. Kalkan was no adept.

"You've heard of hostages?" Pen cut him off. "We may need her, if—"

He half considered puncling the controls in a pattern that would destroy the ship, at least keeping it out of Eurasian hands. That would be safest. But it would only stave off defeat and eventually some Comp would succeed in wrecking the Hemisphere's delicate defenses. A stalemate that was slowly but inevitably slipping was not good enough. Now that detached, observant sector of his mind was humming with emotion, telling him that the time for calculated, limited risks had passed. Win-or-go-bust. Thus it must be.

Doris was lying exactly as he had last seen her, but as he picked her up her eyelids fluttered. Immediately Pen swung so that his body blocked Kalkan's view and one burned, lacerated hand clamped across her mouth. Her eyes looked up at him in wordless appeal and he was sure then, in that instant, that he would fight this thing through to the end.

He waited until Kalkan had gone reluctantly into the power compartment and the hatch between them was closed, readjusting the valve of the oxygen tank while he stalled. Then he dropped to the floor beside the girl.

"He's out of contact now," he whispered. "A bit at loose ends."

Her eyes asked a question.

"He has to handle the Delta or we won't make it back. We can't do anything until then."

While inspecting the damage he had found his blast pistol, dropped from its holster as he dived into the ship. He held it toward her butt first, but still beyond her reach.

"You don't still think I'm a Comp, too?" he asked anxiously.

"Of course not." Doris breathed. But she seemed a little too anxious to get her hands on the gun.

"Then why did you tie me up?"

"You were going to teleport inside the shield."

Pen understood the outraged hor-

tor in her voice. For months every program emanating from Vizaudio Central had harped insistently upon the theme that the use of a single NRT unit would mean disaster, and it was virtually impossible to work with propaganda day after day without being at least somewhat affected. Even thinking of using NRT within the Hemisphere was rank treason.

"All they lacked was the proper evaluation of the McKetrick equations, and they were on the track of those. And we had to get at least the basics of their Delta field-stasis. We knew nothing about it."

"Pen! You knew?" She smiled uncertainly, wanting to believe but with doubt still nagging her mind.

He nodded soberly. "Yes, I knew. But we had to string along with that Comp and outguess the whole Eurasian staff. They were after our McKetrick data."

His face grew grim and bleak. "Only two of us knew, and Fritz Harvey's death was no accident. They got to him with that infernal machine of theirs and I had to kill him before he could give away any of our information."

Doris gasped. Fritz Harvey and Pen had been friends for years.

"I seem to be one of those naturally immune people, but I couldn't trust even the Proserv after that. Or you. Now play dead and shoot fast when I give the word."

He gave her the gun. He had to take the chance.

Her hand reached out to his. "Oh, Pen! I'm so sorry!" She remembered how Fritz had been almost like a brother to Pen and knew what anguish it must have cost him. But the only cure for a Comp, as long as the psycho-compeller remained in operation, was death.

His lips set in a hard line.

"It's done," he declared.

Kalkan slipped something into his pocket as Pen opened the hatch. Pen guessed what it was but did not dare make an issue of it. Not at the moment. They still depended too much upon each other.

"Any answers?" he asked.

"I . . . had difficulty," Kalkan admitted ruefully.

Pen suppressed a smile. Kalkan was bluffing, had been all along. His data had evidently come direct from the Eurasian staff, and so far they had given more than they had received. He imagined there must have been some heated arguments about the advisability of risking their field stasis developments. Now if only—

"That's understandable." He pretended sympathetic understanding. "Conditions are far from ideal. We'll have to use my settings then, without check. You keep the Delta stabilized and I'll handle transmuter power. With the intercontrol wrecked it'll take both of us on the board."

Kalkan ignored Doris as she lay against the bulkhead, and Pen dared not even glance at her for fear of attracting his attention.

They strapped themselves side by side in the twin chairs. Kalkan's big hands hovered tensely over his controls as Pen called the power settings obtained from his instruments.

Then Pen's hand came down on the discharge button.

The glaring nothingness was replaced by an utter unrelieved blackness that extended inside the ship as well as surrounding it. Even the luminous dials were invisible, hidden in the tangible negation of light. Pen felt his body and mind degenerating in some hellish way that was beyond all understanding. His elbow jabbed at Kalkan's ribs.

The other man grunted and Pen heard the switches of the Delta begin clicking. The blurring sensation vanished but the darkness remained.

"Watch it!" he complained. "That was too close to total instability."

He reset the power controls by touch and memory and waited while the capacitors recharged.

"Again," he barked, and hit the discharge button.

This time they were in a universe, but not their own. Miniature planets shot hither and yon at tremendous speeds on utterly improbable looping orbits. The ship and their bodies were huge and nebulous beside the system, and once a planet passed in and out through the walls as though they were nonexistent.

"Size reference wrong. Once more."

Both men breathed a sigh of relief as the teleportation shock died away. Far to one side floated the bluish-yellow ball of a familiar sun and a few hundred miles below was a globe that could only be Earth. Through the shifting cloud shreds they recognized the outlines of the Eurasian land mass. It was like coming in from a moon rocket trip.

"Safe!" Kalkan muttered with relief and satisfaction.

They were falling, and the distance was too short to risk teleportation in this superpowered but unpredictable machine. Pen knew he could never make accurate destination settings by guesswork alone. He had a healthy fear for the Eurasian disruptor network and anti-teleport shield below.

He reached toward another section of the control board, until then unused, and cut in the rocket tubes which on this craft performed the same functions as the rotors on teleporting helicars, for short range travel where there would be danger of teleporting into a solid object. Quickly he adjusted the throttles to slow their drop, riding the jet discharges against gravity.

Kalkan's head snapped around suddenly as though he were awakening from a daze. He reached toward a pocket.

"Now!" Pen shouted.

But from the corner of one eye Kalkan saw Doris move and raise her pistol. The ship lurched violently as one big hand chopped down across the rocket throttles and under unbalanced power the ship spun violently end over end. Without the support of seat belts Doris was flung headlong against the wall before she could aim and fire.

The tiny explosive pellet weapon Kalkan produced looked like a toy in the man's huge fist, but it was a deadly toy. He must have taken it

from Doris. Pen lunged for the larger man's wrist—and missed as Kalkan anticipated the action and drew back. The gun swung to cover him and he could see Kalkan's finger tightening on the trigger. The thin lips were parted in a snarl.

But then an intent, *listening* look overspread Kalkan's face and slowly he pocketed the gun while hate and indecision mingled in his eyes.

That lasted only a second, and then with two quick motions he unsnapped the quick-release buckles of his seat belts. His fists lashed out. Pen's head rocked to the impact of the blows and his sight blurred. Helplessly, dizzily and with a growing sense of defeat, he realized what had happened. He had waited an instant too long. Kalkan had become a full Comp again, and the Eurasian technical staff wanted him alive in order to pick his subconscious mind of its knowledge. If they succeeded—

Deliberately he let himself go limp before he was beaten into unconsciousness.

Kalkan struck him one more for good measure and turned his attention to the controls. He changed the settings, not fumblingly this time but with skill and speed, and pressed the discharge button.

The strain was slight, for they were teleporting without reference to time-curve corrections or multiple dimensions. A shield was the only disturbing factor, the Eurasian shield, and through the psycho-compeller Kalkan responded to its shifting co-ordinates.

Pen slitted one eye and glanced through the forward port as air suddenly screamed around the ship. Atmosphere. A few miles below as they fell, looking from this height like an exquisitely detailed model, lay the multiple domes of the Eurasian Inner Citadel, that almost legendary center from which the autarchs controlled their realm, nerve trunk of the Eurasian Combine. Kalkan, guided by the operators of the psycho-compeller, had brought them through the hitherto impregnable shield, something Pen himself could never have accomplished.

Every hair on his body stood erect and tingled as a disrupter ray set at search focus brushed the hurtling ship. Kalkan screamed something aloud in a foreign language, and as though in answer the ray swept by without concentrating.

A trio of faint golden tractor beams lanced upward. The ship jarred slightly and steadied as they took hold.

Kalkan's reflexes were quicker than those of any normal man. He saw Pen's first movement of desperation and his hands closed vise-like around Pen's wrists. His fleshy face wore a malicious smirk of triumph now, a reflection of the mood of his masters below. He had only to maintain his grip a few minutes longer, keep Pen helpless until the tractor beams brought the ship to ground. Then would come —questioning—and after that quick destruction of the Hemisphere.

Pen tried to jerk free and the skin of his right wrist, cut by the wires

and burned by the electric current, split and peeled away in Kalkan's iron grip. He winced as blood oozed again from the raw flesh.

Blood was slippery. That peculiary detached portion of his mind took note of the fact, evaluated it, and the curtain of bleak despair lifted slightly.

He twisted both wrists again in Kalkan's grasp, enduring the nauseating pain as he deliberately reopened and deepened the wounds. Then his knee came up sharply. Kalkan twisted his body aside but the momentary diversion and slippery blood were enough. Pen wrenched one hand free.

Before Kalkan could interfere his fingers had closed around the materionic corrector control and jerked it full down.

Something stabbed out from the ship as it hung tilted nose down in the grip of the tractor beams. An upward rush of force caught the hull, hurled it end over end and sent the Comp sprawling as the tractor beams winked out. He uttered an inarticulate cry of rage and once more raised the pellet gun.



But by then Pen had unsnapped his seat belts. They met in the middle of the heaving floor, and this time Kalkan lacked his abnormal speed.

They grappled, Pen striving to force Kalkan's weapon aside, and at last there was an instant in which the tiny black muzzle pointed directly at Kalkan's own chest. Pen's fingers clawed for the big nerve at the junction of Kalkan's shoulder and fleshy neck.

They found it, dug in, and Kalkan's hand muscles clenched in involuntary contraction.

Through the nose port, just as Kalkan's warm blood showered over him, Pen caught a glimpse of a ragged, raw scar in the earth where Inner Citadel had stood, half shrouded in a fading cloud of bluish luminescence.

The sobbing disturbed him. He groaned.

The irritatingly repetitious sound broke off.

"Pen!"

He opened one eye. The other was swollen shut. He moved and pain told him he was alive, and so she must be, too. But it meant nothing. He remembered the blue mist and knew he should be feeling the elation of victory. But instead there was only exhaustion and depression and the blind, unreasoning anger he had known would follow that stimulator pill taken earlier in

the evening—or had that been a million years ago?

Doris glanced over her shoulder from where she crouched at the simple rocket controls. There was a nasty cut across her forehead and her clothing, like everything else in the control room, was sprayed with Kalkan's blood. But there was a smile on her face. That made him furious.

"They're destroyed," she said in an awed, small voice. "Shield, psycho-compeller, Inner Citadel, everything! Pen, you did it!"

The ship yawed and veered although it was on an approximately level course. She was a lousy rocket pilot. The air stank acridly from the explosive pellet that had torn Kalkan to quivering shreds. It had been a nitro-type explosive and the fumes were giving him a violent headache. And the oxygen was getting low.

"Not destroyed," he corrected with irrational insistence upon absolute correctness. "Transported. To some forsaken dimension I'm sure not going looking for—if they rematerialized at all. That thing was a high-energy meson stream modulated for energy level and incidence velocities. Sort of a teleportation transmitter—without any receiver. And now watch out for our own dis-grid."

"It's off," she announced. "Our forces were coming through even before we leveled out. Pen, the war's over!"

That didn't seem to matter either.

"Pen. Oh, Pen!"

He grunted sourly. Her voice was keeping him from the blessed balm of sleep.

"Pen, can you ever forgive me? I know I made a mess of things, interfered with all your careful plans. But I didn't know. I was trying to save you from yourself."

Her voice was tearfully appealing, but right then he hated her.

He hated her and the Earth and this ship and the hard floor plates and himself. He sensed some of the possibilities in this thing the enemy had helped him to create, and he hated those, too. Fast interplanetary travel without rocket drivers. Interstellar flight. Perhaps even controlled time travel, though that was uncertain. And it meant that when this thing was fully understood a warp-shield would no longer provide any defense against teleported weapons—his mind shuddered away from the sheer complexity.

This thing would be a basic, upon which thousands of new developments could be founded, and he hated that idea, too. He hated everything. Everything was disgusting. He remembered poor Fritz Harvey.

But that one corner of his mind was still functioning clearly enough to realize all this was a temporary condition. That mental separation was a warning of his overuse of subconscious synthesis. He'd have to leave it strictly alone for a long while. There would be work to be done, but he would have to turn it over to others or go the way poor McKetrick had gone, into idiocy.

What he most wanted right now

was the hammock slung between the two trees behind his house, to relax and sleep forever and ever in the warm sunlight. But he would first have to burn down his laboratory. Otherwise impatience would get the better of him and he would—

That queerly active brain sector was whispering strange and disquieting suggestions about the things that had happened. There had been a pattern, something more than mere chance or luck. The workings of Doris' subconscious mind, active although untrained in S-S techniques? Possible. Probable.

Without her interference he would have had little if any chance, too aware of what was at stake to take the final risks. But she had forced his hand with all her actions, giving him no chance to freeze up.

The subconscious mind was a strange thing—and a woman's subconscious was twice as strange.

"Can you forgive me?" she repeated.

"No!" he said gruffly through swollen lips. "I will not forgive you. Not here and now."

She gasped as though he had slapped her.

"Later," he said. "Back on that little island near Samoa. When I can use these hands again. Now shut up!"

She made a strangled little sound and the floor plates tilted under him. She was a lousy rocket pilot.

But he was sound asleep before she discovered she was actually laughing.

THE END.

THE ANALYTICAL LABORATORY

With short space available this issue, we will present simply the figures—and the brief comment that Jack Williamson's yarn is obviously an outstanding success. It garnered practically a unanimous first-place vote.

Place	Story	Author	Points
1.	. . . And Searching Mind (I)	Jack Williamson	1.13
2.	West Wind	Murray Leinster	2.61
3.	Film of Death	J. Scott Campbell	3.33
4.	Her Majesty's Aberration	René Lafayette	3.63
5.	The Incredible Invasion	George O. Smith	3.91

But we must mention that the "Thiotimoline" article was *much* discussed! Asimov's little hoax was both praised, enjoyed, and cursed.

THE EDITOR.



BRASS TACKS

NOTE ON THIOTIMOLINE

The essence of a poker-face "shaggy dog" type yarn is that it be delivered with a straight face throughout. The reader must gradually, as he progresses, come to the realization that he's been had. Because of this, the thiotimoline article would have been ruined by a straight-forward statement "This is a hoax." But, gentlemen, I insist that there was fair warning to all who read the heading I put on it! And many letters indicate the item was appreciated.

While I cannot promise that we'll give warning in bold-face type on any future hoax articles, considerations of the headings will give a less obvious warning. If you doubt any article, check on the editor's heading comment. The legitimate articles will have straight-forward comment; the hoax-articles will have a definitely tongue-in-cheek crack. On thiotimoline, remember, I said: "This one seems to have escaped from the J.A.C.S.—probably by request!" That, I submit, was not a comment to make on a legitimate article discussing a discovery of such immense philosophical importance as thiotimoline would be if it were real.

The Editor.

Dear Sir:

All references below are to the article, "The Endochronic Properties of Resublimated Thiotimoline" in the March 1948 Astounding Science Fiction.

For twenty years I have been reading your magazine to the exclusion of all others of the type. I am firmly convinced that many of your writers belong to the same fraternity that I do. The ideas show in the stories. Never before have I bothered you with an epistle. Now, however, you must bear the brunt of one.

I have sincerely enjoyed your

various articles that delved into little out of the way crannies of science. Crannies which I seldom came in contact with in any other way. It gave food for thought. Truth is stranger than fiction, I know, and I believe that most of these articles have been authentic.

So, in an accepting frame of mind I struggled through the above named "article." It being somewhat out of my field, I did not realize it as being fishy until I started checking. Needless to say I soon discovered that it was an admirable piece of double talk. Excellent, as such. I and a librarian checked for an hour on the bibliography—and the library is eight miles from my home.

I love good double talk, but when it makes as much sense as this one did, it needs a warning. A quarter I pay for the magazine. That is enough. Four hours I should not have to spend to prove I have been took.

Also, it makes me wonder, "Were the other articles straight?" or did I accept some for gospel? How about the article on "R" time and "T" time a while ago?—John C. Hackett, R. R. No. 5, Grand Rapids, Michigan.

Dear Mr. Campbell:

I must congratulate you on the March, 1948, issue of Astounding Science Fiction. Especially with respect to—listed in order of preference—: Asimov's "Endochronic Properties"; 2, Williamson's "And Searching Mind"; 3, "Film of Death," by J. S. Campbell.

Also for your editorial. I buy the magazine each month knowing that the editorial will be of great interest, regardless of the other contents.

I found "Children of the Lens" unreadable. Possibly it is my fault, but within the admittedly great framework, the novel seemed like an endless succession of "and then—and then—and thens." Insufficiently reasoned or connected.

Now for my question: Is Asimov's "Endochronic Properties" a hoax? If so, fine. It was thrilling and thought provoking. But if it is not a hoax, please follow up with an explanation of the negative times of solution. Do not know when I have read anything so gripping.

Williamson's piece is simply superb, and so is the "Film of Death." Cover, one of your best. Picture of buzzard, gaunt horse and broken windmill by Pat Davis, outstanding.

Re your editorial: Has the C02 and H20 synthesis been tried with various catalysts at varying heats and pressures? Should be a promising line of research, and of great importance.—Paul Bergen, Box 216, Clearwater, Florida.

Dear Mr. Campbell:

The most "astounding" thing in the March issue of Astounding Science Fiction was Mr. Asimov's article, "The Endochronic Properties of Resublimated Thiotimoline!" Despite the impressive title, I was, at first, only casually interested in the article but I read it. I read it again and then a third time and then a fourth. I was dazed! I was



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astounded! I showed the article to a half-dozen different people and discussed it with them. They, too, were dazed, amazed, incredulous. There were the references, graphs, tables, et cetera.

Not one of us even considered the possibility that it might be a joke!

However, at a meeting of the Los Angeles Science Fiction Society one of the members gently pointed this possibility out. Still dazed, I decided to check further: Displaying my usual brilliance, it took me but an hour's research at the library to discover that the references were entirely fictitious!

What a relief! Although, it is not immediately obvious, the whole structure of science and mathematics would crumble if such a little "fact" were true.

I've been wondering about the other article in the magazine. DeCamp even has photographs in his, but still—

This was a good issue: Williamson, Hubbard, Leinster, Smith, deCamp, Asimov, Ley, your editorial, and—Shades Of The Past!—John Scott Campbell. I would have called it perfect if you had had stories by Don A. Stuart, A. E. vanVogtt, and Lewis Padgett, but that would require a good deal more pages.

If only Astounding were biweekly—or, at least, had another hundred pages!

News travels fast among science-fiction fans. Especially, good news so by now almost everyone knows about Street & Smith's intention to issue an Unknown Annual. Let's hope it's an omen of things to come.

—Arthur Cox, 1203 Ingraham Street, Los Angeles 14, California.

Sorry on the title duplication. But a hoax article, to be delivered with the necessary poker face, must be camouflaged as an article.

Dear Mr. Campbell:

Please allow me to be included among those who will write you to this effect:

"Lo! How have the mighty fallen! O Dyan! O Kolla! O, divine Rad! O, for shame! for shame!"

All of which refers to a slight editorial aberration in allowing Author G. O. Smith to entitle his story "Incredible Invasion" when that title had already been used in the 1936 serial by Mr. Leinster.

Secondly, it was probably an oversight to include the story by Mr. Asimov in the "Articles" section, when its obvious place was in the "Probability Zero" section. Mark Twain is alleged to have inserted a paragraph of nonsense right in the middle of a narrative, but in this case the effort by Mr. Asimov was apparently much more noticeable.

Needless to say, I enjoyed the attempted dissertation of fact and do not doubt that many will have been led astray.

Some of the best science stories have appeared as a result of these articles in the past, so please consider this a request for more. How about the latest reports on Venus and Mars as an aid to the fictioneers?—Tom Lovejoy, 536 Merrimac Street, Oakland 12, California.

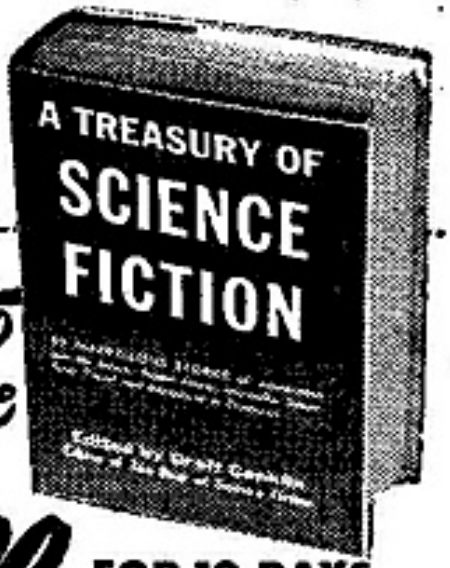
If Thiotimoline were put on a flea's off hind leg, and the flea placed near water, would the thiotimoline be able to know which way the flea would jump?

Dear Mr. Campbell:

I wish to take the trouble to make some additions to the information given in the article about thiotimoline by Mr. Isaac Asimov. I have been in communication with Dr. P. Krum and with Prof. G. H. Freudler for several months over the effects of psychological states of the experimenter on the solution times of the chemical.

It has been discovered that the plateau volume, i. e., the volume at which the solution times cease to increase, is not a true plateau. The curve changes direction continuously at 1.09, 0.04 seconds short of the figure given by Mr. Asimov, in the case of water, and flattens into a more slowly rising curve that may be obscured by impurities in the chemicals. The thiotimoline used by Krum, Freudler, and me is of the fourth resublimation instead of the second, being just that much purer. The water purified especially for these experiments had the minimum of impurities. The endochronometer was built with all electrical circuits super-cooled to reduce resistance, thus gaining greater accuracy of recording. The thiotimoline tube was kept at the constant 25.00°. The maxima of the curve obtained in these experiments is, or, I should say, would be, 1.157 at infinity.

It should be noted that these ex-



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periments were performed by only a few ardent researchers. In order to discover the effects of psychological states of the experimenter on the solution times, a group of chemistry of definite temperament types were chosen and indoctrinated with certain statements in order to make certain that their reactions, anticipations, feelings, et cetera, would be known at the times of the experiments. Solution times varied definitely with the type of individuals doing the experiments. The relaxed individuals had the greatest solution times; the tensest, the shortest; the assertive individuals had average or mean times. Different degrees of relaxation, tenseness, and assertiveness had different degrees of effect on the solution times. There also appeared to be a co-relation between these psychological states and the somato-types formulated by Sheldon in his "Varieties of Temperament", with fat students being most relaxed and getting the longest times, the muscular ones being most assertive and getting the average times, and the leanest ones being tensest and getting the shortest times. There were, of course, exceptions, the most significant being one student who is definitely of the lean, tense type. This student is thoroughly trained in the methods of Korzybski's general semantics. He obtained solution times 0.002 greater than those of the student who got the next highest. Of course, there must be many more experiments before such information can be accepted into the body of scientific knowledge.—Kenneth H. Bonnell, 4749 Baltimore Street, Los Angeles 42, California.

The True (?) story of the mysterious Reelfoot Lake.

Dear Sir;

I read with interest your recent article, "The Endochronic Properties of Resublimated Thiotimoline," by Isaac Asimov. It was very interesting and quite thought provocative. However, the amount of material presented was barely enough to whet an enormous appetite. I should like to see more research conducted and presented on this fascinating subject.

From the sketchy information about the chemical make-up of thiotimoline available in Mr. Asimov's article, the chemical seems to be very similar in composition to a substance developed a few years ago by "Micran Research, Inc.," a company then situated in Reelfoot, Tennessee.

We had been investigating for some time the properties of hydrophiles in hopes of finding some method of fertilizing to combat the drought conditions then prevalent over the entire Mississippi Valley. Our substance—we never named it other than its laboratory designation, R-23—seemed to hold the most promise so our investigations soon centered around R-23. We had hoped to find a hydrophylic compound which would attract and condense moisture about itself. Placed about the roots of a plant, it would,

in effect, water the plant continuously. How disasterously well we succeeded remains to be shown.

We discovered that, with the addition of a certain compound, R-23 lost its dry flakiness and became hard—metal hard. This fact distorted our purpose and changed our research to new lines. We made wire, rods, and various other shapes and extrusions of the new R-23. It was now that we made an important observation of the properties of the compound. It attracted moisture at a tremendous rate and absorbed this moisture in through the sides and ends of the wire. Well, the tendency to absorb this moisture created terrific head inside the wire. The ends had obviously less absorbing area and therefore less pressure. The result of this was a needle-fine jet of water, the diameter the same as that of the rod and a velocity equal to the theoretical $\sqrt{2GH}$, where H was found from H=6.27 times the diameter of the rod squared. It was here that about five of the company engineers—including myself—had—simultaneously—the "Great Idea". Here was the answer to a water-hungry Mississippi Valley. Make one-inch bars of R-23, cut them into two-foot lengths and furnish one to every garden in the valley. Steel caps attached to the ends would allow the water to flow only when wanted.

Once conceived, the project didn't take long to complete. In the short interim of two weeks, every garden in Reelfoot had its "R-pipe", and every pair of lips had its warning to stay closed. The news never did

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leak out and the true story hasn't been told until now.

You see, the R-pipes were made with one end permanently capped and the other with a removable cap for when the R-pipe was used. It was expected that the pressure at the former end would back up and cause twice the pressure at the other end. But such was not the case. The water kept coming from the open end at just the same velocity as when both ends were open, and the pressure merely kept building up higher and higher behind the cap on the other end. Well, sir, the R-23 was all from the same batch and the same was true with the steel in the caps. Also, there were enough R-pipes made the first afternoon to supply all of Reelfoot, and there production stopped until tests were complete.

Exactly eleven days and some-odd minutes after its—shall we say—delivery, the first of those pipes blew its cap. Three more soon followed, and, before the day was over, the entire group were projecting their respective one-inch streams of water. In a few hours there was a foot of water in the streets of Reelfoot. Nestled as it was between Beckers Ridge on one side and a series of low hills on the other Reelfoot had little chance of ridding itself of the excess water. When the water continued to rise, some of us realized the possible danger and urged the inhabitants of the little town to leave while they could. Most of them did, but some— Well, you know the rest! When the crest reached about thirty feet, the unimagined tons of water proved too great a suddenly added burden to the soft, underlying magma of the earth's crust and the entire valley sank.

When asked about the cause of the Reelfoot disaster, scientists, due to the lack of the essential information, were forced to blame the cataclysm on an earthquake. Here is the real story.

* * * * * *

I'm mighty glad to see that you have again accepted "Probability Zero" back into the fold—but why didn't you call it by its true name? —C. R. Bryan, Box 2379, University, Alabama

---

Ah, yes, the turbo-encabulator. But you should give credit to its hard-working inventors—The Arthur D. Little research organization!

Dear Mr. Campbell:

It was with considerable interest that I read Mr. Asimov's article, "The Endochronic Properties of Resublimated Thiotimoline" (March, 1948). No doubt chemists will have greeted this singular compound with the same enthusiasm that mechanical engineers a short time ago afforded to the invaluable device, the Turbo-Encabulator.

Perhaps you are already acquainted with the above gimmick. If not, maybe you would be interested in the basic principles, copiously derived from the report as it fell into my hands:

The idea here, as in ordinary encabulators, was to perfect a machine

which would not only supply inverse reactive current for use in unilateral phase detractors, but would also be able to automatically synchronize cardinal grammeters. The only new principle involved is that the power, instead of being generated by relative motion of conductors and fluxes, was produced by nodal interaction of negetereluctance and capacitive directance.

Mr. Asimov is, of course, familiar with the fuels—high S-valve phenylhydrobenzamine and five per cent ruminative tetryliodohexamine, both having specific pericosities given by P-2.3 phase disposition. *C* is Cholmondeley's annular grillage coefficient. Incidentally, *n* was first measured with the aid of a metapolar refractive pilfrometer—the report refers us to L. S. Rumpleverstein in his "Zeitshcrift for Electrotechnistaticherdonnerblitze", Vol. VII—but this is considered decidedly inferior to the transcendental hopper dadoscope. (See "Proceedings of the Peruvian Nitrate Association", June, 1914.).

Experimentation was halted and the works generally fouled up during construction, mainly because no one realized the full importance of the great quasi-piestic stresses in the specially designed studs holding the roffit bars to the spanshaft. Engineers overcame this wanding simply by the addition of jibing sockets.

At the present time the turboencabulator has reached a high point of development. It has successfully



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been used in the remote control of high-speed squibble-didgins, and may be applied wherever a barescent sker motion is required in conjfinction with a drawn reciprocating dingle arm to reduce sinusoidal dcpleneration.

I sincerely hope Mr. Asimov's article will be the inspiration of a series dealing with similar progress in other scientific fields.

FOR THE LAB:

1. "West Wind. Very good.
2. ". . . And Searching Mind". We hope Williamson gets rid of them this time!
3. "Her Majesty's Aberration". This is a good series. Don't let it get hacky.
4. "Film of Death". Well put together.
5. "The Incredible Invasion". Great Kippered Kommutators! Not one of these again? There was a time when we panted after Smith, but this latest opus should be read under the hood. As a friend, I beg him to take a deserved rest, and restore his good old self.

Art work is improving. Alejandro's covers are superb, and Cartier, Orban and Rogers in the clear-cut school of illustrating have Napoli and Elliot, devotees of the sloppy style, beat by a parsec. As to Pat Davis, one issue is crude, the next passable, and this final, downright good. We will hold our breath.

Take Don A. Stuart out of mothballs, will you, John?—J. C. May, 2334 N. 76th Court, Elmwood Park, Illinois

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Brother, your neck is out about a meter!

Dear Mr. Campbell:

Please tell *Master* Jack C. Rea that youngsters should be seen and not heard. Truthfully, I fully agreed with his opinions, but my letter—incidentally my first to any magazine, although I once submitted a manuscript—rejected, of course—was occasioned by his statement in the February issue that he has 102 copies. I immediately went and counted mine, to find that I have 161.

Including these, and those of the next three or four better known magazines, I have a total of 487.

To the first writer who can top my score, I'll give him any copy I have, issued in 1940 or earlier.—Clarke B. Spangler, Jr., 11730 Otsego Street, N. Hollywood, California.

Look again, Tom—I used the oxygen question as an illustration of a highly important reaction that could not be worked out with radioisotopes.

Dear John:

I always read your editorials first in Astounding. Your science and predictions are usually quite accurate and very interesting. However in the March 1948 issue your prin-

cipal example of the use of isotopic tracers was an unfortunate selection. The question you proposed, "But—does the free oxygen come from the water or from the carbon dioxide—how does that reaction proceed." This problem was solved by the use of O^{18} in 1941. (Ruben, Randall, Kamen, and Hyde, J. Am. Chem. Soc., *63*, 877 (1941.) *The oxygen comes from the water.*

The use of the isotopic tracer technique is rapidly becoming one of the most important reaction mechanism devices ever developed. However, it is a mistake to believe that the end objective of a research program is dependent upon the reaction mechanism. In the majority of cases the objectives are attained before we work out the mechanism. However, the principal value of understanding the mechanism of any type of reaction is that it then can be used to predict new, and perhaps, reactions that would not have otherwise been suggested. Thus the advance can be made faster in any given field if the reaction mechanisms and rates are known.

Glad to see you are keeping Astounding to its high level. I wonder how many people are going to believe Asimov's very clever "article", on Thiotimoline? Being placed in the Article section will fool some, I believe.—Thomas S. Gardner, 155 Jackson Avenue, Rutherford, New Jersey.

* * * *

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BOOK REVIEW

"One, Two, Three . . . Infinity" Facts and Speculations of Science, by George Gamov. The Viking Press, New York. 1947. 340 pages with 128 drawings by the author and 8 plates. $4.75.

"Books exist for one of two purposes—they'll either instruct or entertain." This, at least, is what I have read in a number of places and I do remember quite a number of highly instructive books which were not one bit entertaining. An entertaining book containing no instruction whatever is a bit harder to imagine, but it might be possible. But every once in a while you come across a book which entertains by way of instruction. And because Professor George Gamov's "One, Two, Three . . . Infinity" belongs to this admittedly rare variety I think it only fair to start this book review with a warning.

If what I write should cause anyone to buy Gamov's book, he should make sure that that evening is absolutely date-free. It might also be useful to station your wife, mother, maid or whoever is handy by the telephone to lie on your behalf about your being not home, in bed with a cold, out-of-town or whichever excuse comes handy. Because when you get home with the book you are likely to open it. And then, unless you have the will power of an average Lensman, nothing else will be done on that evening. I know, it happened to me.

It is easy to ask what the theme of the book is, but it is hard to answer this question. It is much easier to describe how one may visualize its contents. You imagine, to begin with, a scientist, an intelligent man with a sense of humor, a specialist who avoided becoming one-sided. In short a man like Professor Gamov. Then you imagine that Professor Gamov has enough time to visit you every evening for about two weeks running. Then you imagine that you have a few friends who know just a little bit about science, about half of what everybody was taught in high school and that these friends will ask an intelligent question from time to time. But their main function is to be silent and to listen. And then you get Professor Gamov going—I don't know how, a few good questions might do the job—and the result will be an extended scientific gabfest, ranging from the theory of numbers to mathematical ideas about space and four dimensions, with some atomic energy and

the arrangement of genes in chromosomes thrown in and ending up with the new Weizsacker theory about the noncatastrophic formation of solar systems which not only explains all the facts but also makes it more than just highly probable that every sun has its family of planets. (Down with Moulton and Chamberlin!)

This is how "One, Two, Three . . . Infinity" *might* have been written, although the probability is that it originated with the painful slowness with which writers give birth to such books. Seriously speaking, the theme of the book is really infinity and how you approach it, whether it is the infinity of pure numbers—proof that the largest imagined prime cannot be the largest prime—the infinitely small of the Microcosmos, the infinitely complex of molecular motion, the infinitely large of the Macrocosmos.

The book begins with a section called "Playing with Numbers." Among the examples is the famous Tower of Brahma, a brass plate with three vertical needles and a stack of sixty-four circular disks on one of the needles. The disks diminish in size, the largest is at the bottom and the smallest on top. The priests have to transfer these disks to another needle, the rules are: one disk at a time, and a disk must be put only on a needle which is either empty or on one where there is a disk larger than the one in transfer. It can be done, but it is tedious, counting one move per second, twenty-four hours a day and three hundred sixty-four and one fourth days per year, the re-establishment of the complete Tower of Brahma on another needle would take 58,000 billion years! After this introduction to numbers which are merely large—in that case $2^{64} - 1$ seconds—you'll be introduced to infinite numbers and how to deal with them, much of it based on the work of Professor Cantor whose methods are explained by reference to African Hottentots who can't count beyond three.

Then we get into "pure" mathematics, defined as branches of mathematics "incapable of any application whatever." There is the famous prime number proof which, astonishingly, has come down to us from classical Hellas. You imagine a very large number which fulfills only one condition, that of being a prime. Then you multiply all prime numbers, 1 times 2 times 3 times 5 times 7 times 11 times 13 and so on up to and including that very large prime. You add "1" to the result. You have a much bigger prime number because, since "1" has been added, it is not divisible by any other. No, we don't know how to construct large primes. Fermat thought that it could be done this way:

$$2^{2^0} + 1 = 5$$

$$2^{2^1} + 1 = 17$$

$$2^{2^2} + 1 = 257$$

$$2^{2^3} + 1 = 65{,}537$$

$$2^{2^4} + 1 = 4{,}294{,}967{,}297$$

but then Euler proved that the fifth of these numbers is not a prime. It is the product of 641 times 6,700,417.

Another formula advanced was $n^2 - n + 41$ where $n = 1, 2, 3, 4$, et cetera, et cetera. This formula holds good for the first forty steps, the forty-first does not yield a prime. The formula $n^2 - 79\,n + 1601$ is even worse, it functions for the first seventy-nine steps, the eightieth goes wrong! (It must be nice to prove something like this in somebody else's formula, but what if you are the one who thought up the formula?)

The section of "Unusual Properties of Space" contains something that one may profitably forget as quickly as possible—else it will waste time like mad, *your* time. It is the question: What is the minimum number of colors with which to print a map so that no two adjoining nations—or states, or counties—have the same color? The only mathematical proof that works is that five colors will always be sufficient. But nobody has ever been able to draw a map, actual or imaginary, for which four colors wouldn't do the job. How to account for that one additional color between experience, imagination and mathematical proof?

Professor Gamov has a fine time with the "Law of Statistical Behavior" which he calls the "Law of Disorder." There we have the case of the drunk who walks away from a lantern. He takes a few steps in one direction, then makes a turn, shallow or sharp, to *any* other direction, a few steps straight ahead, then another unpredictable turn et cetera, et cetera. Question: How far is he from the lantern after a given number of walks and unpredictable turns? (Answer: Most probable distance is the average length of his straight-line walks, multiplied by the square root of their number.)

Now, of course, you know that the molecules in the air perform just such random movements. And just as a number of drunks might for once move away from their lantern in the same direction, all the molecules of the air in your room might for once move in the same direction, possibly to the corner in which you are *not* so that you get a severe case of anoxia in a sea-level atmosphere. The probability that that happens exists, it is

$$10^{299,999,999,999,999,999,999,999,999,999,998}$$

seconds from the starting point of the universe, which is by now 10^{17} seconds old.

Of course if you don't consider a whole roomful of air but a small space, say a cube with an edge 1/100000 of a millimeter long, you will find that once in every second there is a fraction of a second where half the cube is empty. Considering such small spaces there is a so-called *fluctuation of density* which is not a remote possibility, but constant fact. It is this fluctuation of density which makes the sky look blue by scattering the blue rays and which produces the reddening of the sun when setting.

So far I only knew that a virus is something very small and if pressed I might have remembered that the—spherical—influenza virus measures 1/10th of one micron. But from Gamov's book I learned to my surprise that the tobacco mosaic virus—about 3/10th of a micron long and 0.15 microns across—is about "a thousand atoms long" and "some fifty atoms across." Which means that this virus, indubitably a form of matter which we must call "living", consists of only about two million atoms, provided it is solid. It might be hollow, being a coiled molecular chain, in which case it would consist of a mere quarter million atoms.

These are some small samplings and since I happen to know that Dr. von Weizsacker's theory of the noncatastrophic formation of solar systems will be discussed at length in Astounding by Dr. R. S. Richardson I am suppressing the strong temptation of summarizing Dr. Gamov's summary of that theory. Of course you don't have to wait, you can read it in the book tonight.

Except for the photographs all illustrations are by Dr. Gamov himself. They are not masterpieces of draftsmanship, but they are very charming. And they drive home their point.

Willy Ley.

George U. Fletcher: "The Well of the Unicorn," William Sloane Associates, Inc., 119 West 57th

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JULIUS UNGER 6401 — 24th Avenue, BROOKLYN 4, N. Y.

Street, New York 19, N. Y. 1948, xii + 338 pp.

"George U. Fletcher" is a pseudonym of a well-known writer of—mainly— nonfiction, who has also in his time done some science-fiction and fantasy. Perhaps you can guess who he is when I tell you that he has collaborated with me. This novel is a fantasy, and a first-class one.

The story is—like that of "The Worm Ouroboros," to whose *genre* it belongs—laid in a wholly imaginary world, a world of knights and magic, and of castles and empires, and of wars and piracies. The action takes place in Dalarna, a country vaguely resembling medieval Sweden. Dalarna suffers under the tyranny of the Vulkings—so called because their counts are all named Vulk—who rule by a military caste organization and hope to obtain control of the Empire to which they are in nominal subjection. Other powers in this world include the blond heathen of Dzik, across the sea to the west, and the turbulent Twelve Cities, or Dodekapolis, to the south.

The hero, young Airar Alvarson, has been taxed out of his family property by the Vulking power, and joins the scattered elements of revolt against Vulking rule. Airar rises to leadership, has adventures, fights battles and conspiracies, makes mistakes and learns from them, practices magic and has it practiced on him. He makes friends and enemies—pleasantly sinister old Dr. Meliboë the enchanter: the pirate Earl Mikalegon, and others. And women—the lovely Gython, the fisherman's daughter; the rough soldier-girl Evadne of Carrhoene—one of the Twelve Cities—; and finally the Princess Argyra, one of the daughters of the Empire.

But the story is much more than a romance of derring-do, a fantasy of color, movement, and conflict. In it you will find argued out such questions as good and evil, authority and voluntary agrement, and free-will versus predestination. If it has a central theme—(other than that of a simple adventure and conquest)—it is the philosophy of government: how can men be organized to fight for their fredom without irretrievably losing that freedom in the process?

But if you don't want to debate such questions, you can still enjoy the tale as a colorful and fast-moving adventure-fantasy. If you are at all a connoisseur of fantasy, get it.

L. Sprague de Camp.



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